

Quebec (prov.) - 1914
PROVINCE OF QUEBEC, CANADA

TN 27
G3A3
1914
Department of Colonization, Mines and Fisheries

MINES BRANCH

Honourable HONORÉ MERCIER, Minister; S. DUFAULT, Deputy-Minister;
THÉO. C. DENIS, Superintendent of Mines.

REPORT

ON

MINING OPERATIONS

IN THE

PROVINCE OF QUEBEC

DURING THE YEAR 1914



QUEBEC:

PRINTED BY E. CINQ-MARS

PRINTED TO HIS MOST EXCELLENT MAJESTY THE KING

1915

PROVINCE OF QUEBEC, CANADA

Department of Colonization, Mines and Fisheries

MINES BRANCH

Honourable HONORÉ MERCIER, Minister;

S. DUFAULT, Deputy-Minister;

THÉO. C. DENIS, Superintendent of Mines.

REPORT
ON
MINING OPERATIONS
IN THE
PROVINCE OF QUEBEC
DURING THE YEAR 1914



QUEBEC:
PRINTED BY E. CINQ-MARS
PRINTER TO HIS MOST EXCELLENT MAJESTY THE KING

1915

PROVINCE OF QUEBEC
DEPARTMENT OF COLONIZATION, MINES AND
FISHERIES

TO THE HONOURABLE HONORÉ MERCIER,

Minister of Colonization, Mines and Fisheries,

QUEBEC.

SIR,—

I have the honour to transmit to you the Annual Report on the
“Mining Operations in the Province of Quebec for the year ending
December 31st, 1914.”

I remain, Sir,

Your obedient servant,

S. DUFAULT,
Deputy-Minister.

Quebec, May 29th, 1915.

PROVINCE OF QUEBEC
DEPARTMENT OF COLONIZATION, MINES AND
FISHERIES

MR. S. DUFAULT,

Deputy-Minister of Colonization, Mines and Fisheries,

QUEBEC.

DEAR SIR,—

I beg to transmit to you the Annual Report of the Mines Branch for the year ending December 31st, 1914.

This report is on the Mining Operations, Mineral Production and Geological Field Work during the calendar year in question.

On the 22nd of February, a preliminary statistical report was published, subject to revision, as at that early date all the returns from producers had not been received.

The figures now given are revised and, therefore, supersede those given in the preliminary note issued in February.

Yours very obediently,

THÉO. C. DENIS,
Superintendent of Mines.

Quebec, May 29th, 1915.

TABLE OF CONTENTS

	Pages
Letters of transmittal	3, 4
Statistical Review	7
Table of production	9
Legislation	10
Field work	11
Laboratory	13
Exports of mineral substances.....	15
Asbestos	17
Copper and Sulphur ore	27
Zinc and Lead	28
Aluminium	28
Graphite	29
Chromite	31
Gold and Silver	41
Iron	42
Mineral paint	42
Molybdenite	43
Mica	46
Natural Gas	48
Magnesite	68
Building Stone	72
Clays	74
Kaolin	78
Feldspar	82
Sand-Lime Brick industry	88
List of operators of mines and quarries.....	104
Accidents in mines and quarries.....	120

NOTE

In the statistical tables and in the review of the mining industry of the province during the year, the term "production" is synonymous with "quantity sold or shipped", and does not necessarily represent "output". The ore, and other mineral products remaining as "Stock on hand" at the end of the year, are not included in the production figures.

The ton used throughout is that of 2,000 lbs., except when specially mentioned.

The year referred to is the calendar year, ending December 31st, unless specially stated.

We endeavour to give values of the mineral products, raw or manufactured, as estimated at the point of shipment or at the pit-mouth; this, however, is sometimes difficult to obtain.

MINING OPERATIONS

IN

THE PROVINCE OF QUEBEC

DURING THE CALENDAR YEAR 1914

STATISTICAL REVIEW.

The statistics compiled by the Quebec Mines Branch show that the mineral production of the Province during the year ending December 31st, 1914, reached a total value of \$11,732,783. As compared with the previous year, when a value of \$13,119,811 was recorded, this is a decrease of \$1,387,028, or of 10.57%. Owing to the very abnormal conditions which marked the whole second half of the year 1914, it is a matter of gratification that the figures have not shown a greater falling off. As it is, our total mineral production is greater than that recorded for 1912, when it was \$11,187,110.

The revised figures of the mineral production of the Province of Quebec during the year 1914, which we are now presenting, were preceded by a preliminary statistical statement, which was issued on February 23rd, 1915. These preliminary statistics, which were published subject to revision, gave a close approximation, at an early date, of the production of the various mineral substances during the year. In fact, the total given in this early statement only differed by \$407,355, or 3.47%, from the finally revised figures.

The main decrease of individual mineral substances is in asbestos, and this may be directly ascribed to the war conditions, which are also responsible for the very large falling off in mica.

The metallic products this year are responsible for a value of \$874,229, or 7.45% of the total production. This is about the same proportion as for the previous year.

The structural materials figure for \$7,799,290, which is a decrease of \$388,627, as compared with 1913, or a proportional falling off of 4.75%. It is very gratifying that this difference should be so small, for it shows that the building activities in the province did not unduly suffer from the abnormal conditions which prevailed during the latter part of the year 1914.

The following table gives the annual value of the mineral production of the Province of Quebec for the last eleven years:—

Year	Value
1904.....	\$ 3,023,568
1905.....	3,750,300
1906.....	5,019,932
1907.....	5,391,368
1908.....	5,458,998
1909.....	5,552,062
1910.....	7,323,281
1911.....	8,679,786
1912.....	11,187,110
1913.....	13,119,811
1914.....	11,732,783

Following the table of production, a short review of the principal items will be given under the respective heading of the various substances.

TABLE OF MINERAL PRODUCTION OF THE PROVINCE OF
QUEBEC DURING 1914

Substances	Number of Workmen	Salaries	Quantities	Value	Value in 1913
Asbestos, tons.....	3,054	\$1,285,697	107,401	\$2,895,935	\$3,830,504
Asbestic, tons.....			13,251	4,904	20,346
Chromite, tons.....			135	1,210	
Copper and Sulphur ore, tons.....	250	170,403	117,778	801,129	812,899
Feldspar, tons.....	6	1,170	98	2,156	1,554
Gold, ozs.....			996	21,064	14,794
Graphite and Magnesite, tons.	72	17,127	620	21,126	12,955
Iron ore, titaniferous tons.....					9,824
Kaolin, tons.....	27	15,000	1,000	9,000	4,354
Mica, lbs.....	183	40,805	491,374	67,278	117,038
Mineral Water, gals.	19	4,151	115,580	23,569	31,728
Mineral Paint (ochre) tons.....	53	18,141	5,690	36,600	40,868
Phonolithe, tons...			627	2,114	
Phosphate, tons....	31	6,820	635	5,057	3,506
Quartz, tons.....	3	52	200	525	2,363
Silver, oz.....			57,426	31,809	21,791
Zinc and Lead ores, tons.....	15	11,047	969	10,017	7,370
STRUCTURAL MATERIALS					
Brick, M.....	1,166	434,580	137,057	1,094,531	1,297,592
Cement, bbls.....	870	748,263	2,840,436	3,325,055	3,361,292
Granite.....	541	325,161		582,235	496,588
Lime, tons.....	258	150,813	1,680,977	391,622	464,424
Limestone and Marble.....	1,927	887,008		1,745,855	1,824,748
Sand.....	317	94,791	853,437	446,532	405,750
Sandstone.....					5,072
Slate, sq.....	20	9,309	1,071	5,105	6,286
Tile, drain and sewer pipe, pottery, etc.	159	71,397		208,355	326,165
	8,971	\$4,291,735		\$11,732,783	\$13,119,811

LEGISLATION.

An important amendment to the Mining Law was passed at the last session of the Quebec Legislature. This amendment concerns the conditions under which mining rights for oil and gas may be obtained from the Government. Our law, previous to this measure, made no distinction between metalliferous mining claims and oil or gas claims, and these latter could only be taken up under the terms and conditions which obtained for the former ; or else, under very special conditions or circumstances, an order-in-council could be passed, in accordance with an old law (articles 6239-6244 of the Revised Statutes, 1909) granting larger territory and special privileges for the exploitation of natural gas. During last session, the articles in question (6239-6244) were repealed, and replaced by the following articles introduced in the Mining Law.

“2137*a*. Lands containing combustible natural gas, mineral oil or naphtha, may be staked or placed under a license either ordinary or for a long term, upon the conditions hereinafter set forth :

a. No staking or license shall cover more than 1280 acres ;

b. In surveyed territory the area staked out or covered by a license shall consist of whole lots or regular fractions of lots ; in unsurveyed territory, such area shall form a rectangle, but, in either case, the width of the claim shall not be less than one-half its length.

c. The holder of a miner's certificate who wishes to obtain an ordinary license, must :

1. Produce an accurate description and a regular survey plan of the ground applied for ;

2. Pay the sum of \$10.00, as a fee, and an annual rental of ten cents per acre.

d. Such license is valid for one year only, and is renewable once only on the same conditions ;

e. At the expiration of the renewal or of the original license, on proof of the discovery of combustible gas or of naphtha in appreciable quantity, the holder must provide himself with a special or long term license covering a period of ten years, at an annual rental of twenty-five cents per acre, payable in advance. This latter license is renewable by ten-year periods, as long as the mineral lasts, and upon payment of the same rental of twenty-five cents in advance. (5 Geo. V, ch. 35).

“2137*b.* The staking out for marking a claim, or the issue of an ordinary or long term license, shall be effected in accordance with the formalities prescribed by the foregoing article 2126, and with the same effect, except that the direction given the side lines is optional, and the inscriptions are repeated on each of the stakes, with a mention, moreover, of the length and direction of the lines, and that the staking is done with a view to prospecting for gas and petroleum. (5 Geo. V, ch. 35).

2137*c.* No renewal of an ordinary license, or issue of a long term license, shall be granted, unless it be established, by affidavit at least, that work has been done to the value of \$1.00 per acre, for every acre under license.

If the holder of a long term license ceases to bore or mine in the area covered by the license for a year, or does not continue doing so in good faith, the license may be cancelled after a notice of three months, during which period the holder may resume work at the Minister's discretion.” (5 Geo. V, ch. 35).

FIELD-WORK.

The most important field-work undertaken by the Quebec Mines Branch during the summer of 1914, was the investigation of the copper deposits and resources of the Eastern Townships by Dr. J. A. Bancroft, professor of Geology at McGill University. This investigation is now completed, and the report is in press. The thoroughness and care with which this work was performed can only be judged by the report, comprising some 200 pages, which will soon be available to the interested public.

Regarding the value of work of this nature and the use which the interested public can make of it, we will quote from our last report :—

“The importance of such field-work does not need to be emphasized. Its main object is to call attention to the possibilities of our mineral resources, and also to protect the investing public against exaggerated statements and frauds, by giving as wide publicity as possible to accurate descriptions of our mineral districts, their geology, their possibilities. That this has been one of the features of the Quebec Mines Branch will be realized by referring to the Annual Reports and to the Special Reports published in the last few years where will be found plain statements of observed facts, accurate descriptions of mineral occurrences, prospects and mines in such districts as Keekeek lake, Kienawisik, Chibougamau, Opasatica lake, Fabre township, and numerous others.

If the public would avail itself more of the information at its disposal in the Quebec Mines Branch, published as well as unpublished, as to the possibilities of mineral districts, instead of being lured by plausible promoters into buying stock certificates in mining ventures of which they are, technically speaking, in absolute ignorance, a great deal of disappointment and heart-burning would be spared.

It may also be mentioned that the Federal Department of Mines has published and is publishing every year, a vast amount of information concerning the mineral resources and the geology of the Province of Quebec, which can be drawn upon by the interested public. The two branches of the department, the Geological Survey and the Mines Branch, have their headquarters in Ottawa, and their publications can be obtained on request to the Directors.

Mining enterprises, when reduced to a business basis, with the right assistance and advice, are, on the whole, quite as safe as farming, commercial and industrial enterprises. But to be legitimate mining enterprises, they must be based on actual knowledge, on observed facts, and be devoid of the imagination which makes up the greater part of the unscrupulous promoter's prospectuses.

For one thing, careful discrimination should be made by the

investor between prospecting or developing ventures, and the exploitation of producing mines, or mines sufficiently developed, with ore blocked out to ensure success. Searching, prospecting and developing are naturally hazardous. When successful, the returns from such investments are very large, but the proportion of failures to successes is very great. Investments of this nature are certainly not for the small savings, which should always remember that the risk is proportionate to the returns. If the investor expects large returns, he has to take risks of losses. As many know to their cost, there are stocks, mining and others, which are very easy to buy, but extremely difficult to sell at any price."

CHEMICAL LABORATORY.

The Quebec Mines Branch maintains at the Polytechnic School, 228 St. Denis street, Montreal, an up-to-date, well equipped assay and chemical laboratory, for the convenience of the interested public. Analyses and assays, determinations of mineral specimens and tests of various kinds of ore, samples and materials found within the boundaries of the Province of Quebec, are made in this laboratory at prices which are extremely low for the high-grade work done. The laboratory has been installed for the sole purpose of aiding the development of the mineral industry of the Province of Quebec. Prospectors and all persons interested in the Quebec mineral resources are cordially invited to avail themselves of the facilities offered. The tariff in force for the analysis and assay of various substances is given further on, and it will be realized that the fees are very low, as the high competence of the chemists insure results of undoubted reliability.

During the year ending December 31st, 1914, the Provincial Laboratory effected 361 analyses and assays as follows:—

Gold and silver, 106; alumina, 4; carbon, 5; lime, 10; copper, 23; tin, 1; iron, 30; magnesia, 10; manganese, 1; molybdenum, 1; nickel, 6; lead, 2; potash, 1; phosphorus, 2; platinum, 2; silica, 28; sulphur, 14; titanium, 2; uranium, 1; zinc, 2; chlorine, 2; water, 2; volatile matter, 3; ash, 8; radioactivity, 11; density tests, 3; crushing strength, 3; fusion tests, 5; concentration tests, 3; qualitative determinations, 20; identification of minerals, 19; tests on asphalts, 21; abrasion tests, 4; separating tests, 4.

PROVINCE OF QUEBEC

GOVERNMENT ASSAY LABORATORY

(Under the direction of the Department of Mines of the Province of Quebec as an aid to the development of the mineral resources.)

TARIFF OF FEES FOR ASSAYS AND ANALYSES

DETERMINATIONS	Less than 5 samples Each:	For 5 samples or more Each:
	\$ Cts.	\$ Cts.
Moisture.....	0.25	0.25
Combined Water.....	0.50	0.50
Gold and Silver.....	1.00	0.90
Silica, Copper, Iron..... Iron, in titaniferous ore; \$2.00	1 constituent 1.00	0.90
	2 constituents in same sample 1.75	1.50
Graphite, Alumina, Lime, Magnesia, Sulphur, Lead Nickel, Cobalt.....	1 constituent 1.50	1.35
	2 constituents in same sample 2.50	2.25
Antimony, Zinc, Manganese, Chromium, Titanium, Arsenic, Phosphorus, Platinum, Bismuth.....	1 constituent 2.00	1.80
	2 constituents in same sample 3.50	3.15
Commercial analysis of an iron ore, comprising determination of silica, iron, phosphorus, titanium and sulphur.....	6.50	5.85
Commercial analysis of a limestone or cement, comprising: silica, lime, iron, alumina, magnesia, and sulphuric acid.....	6.00	5.40
Commercial analysis (proximate analysis) of a fuel, comprising: ash, volatile combustible, fixed carbon, moisture.....	3.00	2.70
Calorific power of a fuel.....	1.50	1.35
Radioactivity of a mineral.....	1.00	0.90
Radioactivity of a mineral water.....	2.00	1.80

Determination of Minerals.—For a nominal fee of 25c for each sample, the laboratory will make determinations of ores and minerals, provided rapid tests will allow it, and issue a report on probable contents and commercial value of specimens and samples.

Terms.—Money in payment of fees, by registered letter, postal notes or orders, must invariably accompany the samples, in order to insure prompt return of certificate.

Professor E. DULIEUX,
In charge of Laboratory.
No. 228 St. Denis St.
Montreal.

INSPECTION OF MINES.

In November, 1913, Mr. J. H. Valiquette, the Assistant Inspector of Mines, resigned from the staff of the Quebec Mines Branch to accept a much better remunerated position in Montreal. For nearly one year, the Superintendent of Mines was the only technician on the staff, and the inspection of mines, from the standpoint of the security of the workmen, could not be carried out as frequently and systematically as had been intended.

In October, 1914, Mr. A. O. Dufresne, a mining engineer, graduate of both the Polytechnic School and McGill University of Montreal, was appointed Assistant Superintendent of Mines, and given charge of the mine inspection. He has, therefore, written the part relating to "Accidents in Mines", and has, besides, prepared the article on the manufacture of silica bricks.

EXPORTS OF METALS AND MINERAL SUBSTANCES.

Owing to the state of war now existing in Europe, the exportation of certain metals and mineral substances has been made the object of special regulations by order-in-council, which were signed by the Governor-General on April 13th, 1915.

A.—The exportation of the following goods is prohibited to all destinations other than the United Kingdom, British Possessions and Protectorates, France, Russia (except Baltic ports), Japan, United States, when for consumption in United States only, or shipped to specified consignees in United Kingdom via United States, or exported via United States under license or dispensation from Canada :

Coal,

Mica and Micanite.

B.—The exportation of the following goods is prohibited to all destinations abroad other than the United Kingdom, British Possessions and Protectorates :

Nitric Acid,

Peroxide of Manganese,

Potash Salts,
Sulphur,
Sulphuric Acid,
Explosives of all kinds,
Antimony, Sulphides and Oxides,
Copper Sulphate,
Zinc Sulphate,
Ferro-Chrome,
Ferro-Manganese,
Ferro-Molybdenum,
Ferro-Nickel,
Ferro-Titanium,
Ferro-Tungsten,
Ferro-Vanadium,
Spiegeleisen,
Ferro-Silicon,
Graphite, including foundry Plumbago and Plumbago for lubrication,
Alumina,
Aluminium and alloys,
Antimony and alloys,
Bauxite,
Chrome ore,
Cobalt,
Copper, unwrought and part wrought, including alloys of copper.
Lead, pig, sheet or pipe,
Lead ore,
Manganese and Manganese ore,
Mercury,
Molybdenum and Molybdenite,
Scheelite,
Selenium,
Tin and Tin ore,
Tungsten,
Vanadium,
Zinc and Zinc ores,
Petroleum, gas, oil.

C.—The exportation of the following goods is prohibited to all foreign ports in Europe and on the Mediterranean and Black Seas, other than those of France, Russia (except Baltic ports), Belgium, Spain and Portugal :

Asbestos,
Copper ore,
Iron ore,
Iron, hematite pig,
Iron pyrites,
Nickel and Nickel ore.

ASBESTOS.

Returns of shipments were received from ten producers, representing fourteen mines, as follows :—Asbestos & Asbestic Co., Asbestos Corporation (3 mines), B. and A. Company, Bell Asbestos Co., Black Lake Asbestos & Chrome Co. (2 mines), Frontenac Asbestos Co., Jacobs Asbestos Co., Johnson's Company (2 mines), Ling Asbestos Co., and Martin Bennett Asbestos Company. Of these, the Frontenac Asbestos Company and the Ling Asbestos Company did not operate, but shipped from stock on hand.

The total tonnage of asbestos bearing rock quarried during the year was 2,127,395 tons, against 2,527,410 tons the previous year, a decrease of 15%.

The total sales amounted to 107,401 tons, valued at \$2,895,935, as compared with 136,609 tons, valued at \$3,830,504 in 1913, which represent a decrease of 21% in tonnage and 24% in value.

The stock on hand increased considerably from 20,741 tons on January 1st, 1914, to 31,792 tons on January 1st, 1915.

The following tables will give the details of the production of asbestos for the last four years :—

PRODUCTION OF ASBESTOS FOR 1914

Designation of Grade	Shipments			Stock on Hand	
	Tons	Value	Average value per ton	Tons	Value
Crude No. 1.....	1,336	\$402,417	\$301.96	985	\$ 301,237
Crude No. 2.....	2,812	370,776	131.85	1,345	187,688
Mill Stock No. 1.....	10,485	633,289	60.40	2,737	166,761
Mill Stock No. 2.....	32,847	818,765	24.93	9,757	231,874
Mill Stock No. 3.....	59,921	670,688	11.18	16,968	204,429
Totals.....	107,401	2,895,935	26.96	31,792	\$1,091,989
Asbestic.....	13,251	4,904			
	120,652	2,900,839			

Quantity of rock mined during year 1914.--2,127,395 tons.

PRODUCTION OF ASBESTOS FOR 1913

Designation of Grade	Shipments			Stock on Hand	
	Tons	Value	Average value per ton	Tons	Value
Crude No. 1.....	2,140	\$ 588,310	\$275.00	880	\$ 247,787
Crude No. 2.....	2,870	384,559	134.00	1,522	178,767
Mill Stock No. 1.....	14,056	829,440	59.00	4,545	278,374
Mill Stock No. 2.....	29,525	817,963	27.75	3,862	121,545
Mill Stock No. 3.....	88,018	1,210,232	13.75	9,932	112,825
Totals.....	136,609	\$3,830,504	\$28.04	20,741	\$ 939,298

Quantity of rock mined during year 1913.—2,527,410 tons.

PRODUCTION OF ASBESTOS FOR 1912

Designation of Grade	Shipments			Stock on Hand	
	Tons	Value	Average value per ton	Tons	Value
Crude No. 1.....	1,941	\$ 510,785	\$263.16	867	\$ 221,215
Crude No. 2.....	3,766	379,445	100.76	2,867	310,596
Mill Stock No. 1.....	3,682	237,203	64.42	2,370	137,106
Mill Stock No. 2.....	32,689	1,018,960	31.17	8,234	301,774
Mill Stock No. 3.....	69,097	912,691	13.21	6,838	131,515
Totals.....	111,175	3,059,084	27.52	24,176	\$1,102,206

Quantity of rock mined during year 1912.—1,870,608 tons.

PRODUCTION OF ASBESTOS FOR 1911

Designation of Grade	Shipments			Stock on Hand	
	Tons	Value	Average Value per ton	Tons	Value
Crude No. 1.....	1,400	\$ 388,224	\$277.30	1,358	\$ 360,304
Crude No. 2.....	3,382	382,980	113.68	3,368	431,548
Mill Stock No. 1.....	6,340	415,559	65.54	3,794	207,403
Mill Stock No. 2.....	35,991	1,091,784	30.33	12,272	379,523
Mill Stock No. 3.....	55,111	747,759	13.57	12,959	204,298
Totals.....	102,224	3,026,306	29.60	33,751	1,583,076

Quantity of rock mined during year 1911.—1,759,064 tons.

The following table shows the remarkable growth of the asbestos industry during the last twelve years. It will be noticed that in 1913 the value of the shipments of this substance were more

than four times that of the shipments of 1903, to fall back to three times in 1914 :

Year	Tons	Value
1903	29,261	\$ 916,970
1904	35,479	1,186,970
1905	48,960	1,476,450
1906	61,675	2,143,653
1907	61,985	2,455,919
1908	65,157	2,551,596
1909	63,965	2,296,584
1910	80,605	2,667,829
1911	102,224	3,026,306
1912	111,175	3,059,084
1913	136,609	3,830,504
1914	107,401	2,895,935

During the first six months of 1914, the outlook for a large production was very promising, the shipments for the first half of the year being in excess of the corresponding period in 1913. But, with the declaration of war in August, 1914, the demand diminished to such an extent that during the last five months of the year, the conditions of the market were such that most of the producers were compelled to practically discontinue operations or decrease them to a fraction of what they would have been under normal conditions. Germany was an important consumer of our asbestos, much more than appears from the export figures, as most of the exports to Belgium were to Antwerp, in transit to German factories, and moreover, some Canadian asbestos was shipped to that country from the United States.

However, since the middle of January, 1915, a great improvement has been noticed in the asbestos market and the mines are now resuming their activity.

The classification which we have adopted for the grades of asbestos is arbitrary. In Crude No. 1, we put all hand-cobbed asbestos valued at \$200 a ton and over; Crude No. 2 is hand-cobbed asbestos valued at less than \$200. Mill Stock Nos. 1, 2 and 3

are, respectively, \$45 and over ; between \$45 and \$20, and under \$20 a ton.

By deducting the value of the stock on hand as estimated at the beginning of 1914, we see that from 2,127,395 tons of rock quarried during the year, a value of \$3,053,530 of asbestos was extracted, which would give the average yield per ton of the rock as \$1.44 of asbestos. In 1913, this average was \$1.45 ; in 1912, it was \$1.38, and in 1911, it was \$1.53. These figures have to cover all expenses of quarrying, milling, grading and sacking of the asbestos, and profits.

Last year the industry gave work to 3,054 men, who received \$1,285,697 in wages and salaries.

Twelve mines were operated during the year by eight companies, at Thetford Mines, Black Lake, Asbestos and Robertson. None of the East Broughton mines were re-opened in 1914.

The *Asbestos & Asbestic Company* are the only operators in the Danville district. They work the Jeffrey mine situated at Asbestos, in the township of Shipton, four miles to the south of Danville. As mentioned in our last report, this progressive company is introducing radical changes in their method of working, and it is only owing to the very unfavourable industrial conditions which followed the opening of hostilities in Europe that these changes are not completed. The cable-derrick method of hoisting is being replaced by an incline and mine-cars, from the bottom of the quarry to the mill. The rock will all be crushed in an immense Blake crusher, installed in the pit, and which will take blocks sufficiently large to do away with all block-holing. A short description of this crusher, taken from the *Engineering and Mining Journal* may be of interest.

“The crusher now under construction by the Traylor Engineering and Manufacturing Company, Allenton, Penn., is to be used at the plant of the H. W. Johns-Manville Co. at Asbestos, Quebec, Canada, and the rock to be crushed is asbestos-bearing. Because of the slippery nature of the rock, it was necessary to have the angle of nip rather acute, viz., 18°. The side plates are

of rib design and were cast in two parts. The end plates are one piece. The crusher will be 19 ft. 7½ in. long, 11 feet high and 18 ft. 11½ in. wide, and will weigh 500,000 lbs. The machine is made of cast steel throughout, with manganese-steel crushing plates, check plates and toggle seats. A better idea of the size of some of the working parts can be obtained perhaps from their dimensions, notably those of the shafts. The main shaft is 23 in. in diameter, and the swing-jaw shaft 19 inches. The size of the feed opening is 60 x 84 inches, and, under working conditions, will deliver a 10-in. product. As an indication of its capacity, when crushing down to 14 in., it will crush approximately 1,000 tons per hour. When crushing to 10 in., its capacity with asbestos rock is expected to be 3,000 tons per 8 hour day.

Asbestos Corporation of Canada worked three mines out of the five which are owned by the company. The mines operated during 1914 were the King's Mine and the Beaver Mine, both situated at Thetford, and the British-Canadian Mine at Black Lake.

At the King Mine or quarry, a depth of over 250 feet has been reached. A rather radical innovation in the system of hoisting has been introduced. A new cable-derrick has been installed, of very large dimensions. The cable spans the pit lengthwise, instead of across the width as formerly. The length of the cable between the supporting towers is 900 feet. The capacity of the hoisting-box is six tons of rock.

The difference between this new installation and the old derricks may be gathered from the fact that the latter have a span of 350 feet and the hoisting capacity one ton of rock. The new cable-derrick has been tried and found very satisfactory. The intention is to replace the 13 small cable-derricks which span the width of the pit, by three large ones disposed lengthwise. Moreover, it is intended to build a storage bin of a capacity of 25,000 tons, to render the mill and the mine temporarily independent of each other as to supply of rock.

The *Black Lake Asbestos and Chrome Co.* worked both the Union and the Southwark mines, at Black Lake, on lots 27 and 28, range B, of the township of Coleraine.

The *Bell mine* worked very steadily during the first six months of the year, but, like the others, had to considerably curtail operations during the latter part. This mine is the only one which has done underground development work by tunnels, and they have now a large reserve of asbestos rock.

The *Martin-Bennett Asbestos Mining Company* operate the Ward-Ross property on lot 27, range V, of Thetford township. There are two pits, one on the south of the Quebec Central Railway, and the other to the north. In the southern pit the rock is brought to the surface by means of an incline tunnel.

A new company which acquired lots 5 and 6, range IV, of Coleraine, the *Beaver Asbestos Company*, has done a considerable amount of stripping and has sunk numerous test-pits. It is said that the results have been very satisfactory and that a mill will be built during 1915. The general offices of the company are in Windsor, Ontario.

ASBESTOS IN OTHER COUNTRIES.

UNION OF SOUTH AFRICA.—According to the Report of the Mines Department of the Union of South Africa, the production of asbestos in 1912 amounted to 1,087 tons, valued at £18,822, which is a decrease of nearly £2,000 as compared with the previous year. This mineral occurs at Westerberg in the Prieska division; at Koegas in the Hay division, and in the Kuruman division.

CYPRUS.—The Cyprian Mining Co., with mines at Annandos, reported a production of 769 tons, valued at £6,264 for 1912.

WESTERN AUSTRALIA.—The presence of asbestos has been known for some years at Soanesville, in the Pilbara district, but although considerable prospecting work has been done on these deposits, it cannot yet be said that they have been proven as being of economic value. Mr. T. Blatchford, assistant geologist of the Department of Mines of Western Australia, describes these occurrences at length in Bulletin No. 52 of the Geological Survey, Western Australia, Perth, W.A., 1913. The following are extracts from this report:—

The Soanesville Deposits.—These deposits are found in some rough country lying to the west of the Shaw river. Roughly, they are about 65 miles southwest from Marble Bar, and 110 miles to the south of Port Hedland.

Briefly, the geological features are a mass of highly basic rock, probably an altered peridotite, now a serpentine which has since been intruded by several dolerite dykes.

As seen in the field, the serpentine rock forms a belt of rock exposed at the surface for a maximum width of half a mile and a length of some two and a half miles. That these are not anything like the true dimensions is borne out by the fact that in no instance could the true boundaries be defined.

The following is a chemical analysis of a typical sample of the serpentine from this locality, made in the Survey laboratory :

	Per cent
SiO ₂	38.84
TiO ₂	0.04
CO ₂	trace
P ₂ O ₅	trace
H ₂ O	12.81
K ₂ O	0.13
Na ₂ O	0.10
CaO	0.03
MgO	34.06
MnO	trace
FeO	0.53
Fe ₂ O ₃	9.63
Al ₂ O ₃	2.10
Cr ₂ O ₃	0.79
S	0.10
H ₂ O	1.00
Total.....	100.16

Although seams of asbestos have been found in many places on

the area included in the accompanying map, Plate IV, prospecting has not been carried on to any extent, except in two vein deposits on its northern end.

Locally, these deposits are known as "A" and "B" lodes, the "A" being on the western and the "B" on the eastern side of the main dolerite dyke.

The workings on "A" lode consist of two shafts sunk to a vertical depth of 54 and 97 feet respectively, and connected, I believe, at the 50 feet level, with a drive 163 feet in length. These workings were inaccessible at the date of my visit. On the surface, the occurrence of the asbestos veins was apparent. Here the dolerite dyke forms the hanging wall to the asbestos veins, and I believe the same obtains at the bottom of the shafts and the drive. The dyke underlies to the east at an angle of about 70 degrees and, I think, approximately north-east to south-west.

The veins of asbestos are lying close up to the dolerite dyke, and run parallel to the same, forming a kind of banded formation about two feet in thickness. The fibre of the asbestos is short and fit only for mill treatment, as there is scarcely any long enough to warrant cobbing for crude. The fibre near the surface is much decomposed, judging from the material on the dumps, but improves in quality as greater depths are reached. Further to the north, and close to the dyke "A", the lode has been traced for a considerable distance, but does not apparently improve in size or quality. A tunnel has also been driven westward for a distance of 54 feet into the serpentine to try and locate fresh seams. In this tunnel there is no evidence of asbestos veins, in fact the reverse, for the serpentine rock throughout is very much altered and full of joints, probably due to contact metamorphism caused by the dolerite dyke.

On the "B" lode five shafts have been sunk to vertical depths of from 55 to 144 feet.

The two deepest, viz: the "Whip Shaft" and "No. 1 West", are connected by a drive at the 140 feet level. This drive is in all about 300 feet long, and exposes the asbestos veins for the whole of that distance. The average width of the veins here is

slightly greater than that in the "A" lode, and is about two feet six inches to three feet, taken for the whole length of the drive, with fibre showing in both faces. In the northern end of the drive, some very fine asbestos fibre was showing, and I was informed that this was the bottom of a shoot of ore which was some 30 feet in length, and from which most of the cobbled ore had been won. Some of the fibre in this part of the lode had a length of several inches and was of exceptional quality. The fibre in the other portion of the drive was only fit for mill treatment. All the fibre veins, as in "A" lode, are lying close up to the dolerite dyke, the dyke forming the footwall of the "lode".

TASMANIA.—In Bulletin No. 18 of the Department of Mines of Tasmania, (Hobart, Tasmania, 1914), Mr. Loftus Hills describes occurrences of asbestos on Macquarie Harbour, at what is known as Asbestos Point. He describes the occurrence as follows :—

"The existence of asbestos in this locality has been known for some years, and an asbestos reward was granted to H. Grice on 1st July, 1900, the section number being 4767-93m. The reward was in force for five years, and the section became vacant in 1905. Practically no work was done on the section during the currency of this lease.

Quite recently, however, attention has been paid to the deposits by Mr. J. R. Ross, who has done some trenching work on the outcrops, and a company is now being formed to investigate the extent of the asbestos-bearing zone.

The work attempted so far has consisted in the cutting of three trenches, each about 12 feet in length and 5 feet deep. In each of these trenches there are shown ramifying veins of chrysotile asbestos varying in width from 1 inch down to a mere paper-like film. The width over which the asbestos veins are seen to occur is approximately 120 feet, but it must be understood that the whole of this width does not carry asbestos veins, as there are patches of barren serpentine between the rich portions."

COPPER.

Returns of shipments of pyrite ores from the Eastern Townships were received from four operators in 1914. These were P. E. Beaudoin, from the Stratford prospect located on lot 8, range VI South-West of Stratford township; The Eustis Mining Company, from the Eustis mine, near Lennoxville; N. S. Parker, from the Ives mine at Eastman, and the Weedon Mining Company, who took over the property of the East Canada Mining and Smelting Company, on lot 22, range II of Weedon.

The total shipments amounted to 117,778 tons, as compared with 87,550 in 1913, an increase of 30,228 tons or 34.5%. These shipments had a total contents of 6,458,979 lbs of copper in the ore.

The two heaviest shippers, the Weedon Mining Company and the Eustis Mining Company, report a very successful year of operations. At these two mines, development work is kept well in advance of mining, and the Eustis mine has now (April, 1915) reached a depth of 3,680 feet on the slope, from the original surface opening.

At the Weedon mine, the main slope (40°) is now over 500 feet long.

Substantial shipments of iron pyrites, containing a trace of copper, were made by Mr. P. E. Beaudoin, (La Cie. Minière de Cuivre et Or) from the Stratford prospect.

This ore, which presumably was used for the sulphur contents, was shipped to Hamilton, Ont. The mine is now equipped with boilers, hoist, compressor, etc. The ore is teamed to St. Gérard, a distance of seven miles.

The ore of the Ives mine is chalcopyrite. Some 80 tons of 11.5% copper were shipped during the first part of the year, but in September, after the declaration of war, work was stopped.

An investigation of the possibilities of the copper deposits of the Eastern Townships was begun for the Quebec Mines Branch in 1913, by Dr. J. A. Bancroft, Professor of Geology at McGill

University, Montreal. This work in the field was continued in 1914, and a very complete report on the subject is now being prepared, and will be published by the Department of Colonization, Mines and Fisheries.

ZINC AND LEAD.

Very important development work has been carried on on the zinc and lead deposits of Montauban township, in Portneuf county. There are now three companies interested in these deposits, and the possibilities of their becoming the source of an important industry are very promising.

Mr. Pierre Tétreault, of Montreal, worked on lot 40, range I, on which is built a concentrating mill. A considerable amount of development was done in two places, comprising a shaft, drifting and incline.

In October, 1914, the Weedon Mining Company acquired from Mr. Pierre Tétreault a part of the mining land which he controlled, and they immediately began to work very actively on erecting a head-frame, doing further development work and remodelling the concentrating mill.

The Laurentide Mining Company, during the first part of the year, did development work on lots 6 and 7, range V, on what appears to be a mineralized zone between gneisses and a micaceous schist. On lot 6, a shaft was put down to a depth of 30 feet, and on lot 7, another shaft was 41 feet deep in July. The ore is a mixture of galena and zinc blende.

In August, the Laurentide Mining Company started work on another group of claims, on lots 44 and 45 of range I, Montauban, and the prospects are very promising.

ALUMINIUM.

Although the Province of Quebec does not produce ores of aluminium, it is interesting to note that one of the most important plants of the continent, for the reduction of alumina and the pro-

duction of metallic aluminium, is located at Shawinigan Falls, north of Three Rivers, where it has been operating successfully since 1903.

The operators of this plant are the "Northern Aluminium Co.", an offshoot of the Pittsburgh Reduction Company. The name of this latter company was changed in 1907 to "The Aluminium Company of America", but the Canadian subsidiary was not affected and retained its name and identity.

Owing to the policy of reticence which was formerly adopted by the producers of aluminium, it is rather difficult to follow the progress and development of the industry since its beginning. But a rough idea may be formed from the fact that the estimated capacity of the Shawinigan Falls Works, in 1904, was 3,100,000 lbs. of metallic aluminium per year⁽¹⁾, whereas, according to the Department of Mines, Ottawa,⁽²⁾ the present capacity of these reduction works is over 17,000,000 lbs.

The ores used are all imported from France, United States and Germany. The power plant of the Company develops 40,000 h.-p. The Hall-Heroult process of electric reduction is used, and the aluminium is cast in bars and blocks, and some is manufactured into wire in a well-equipped wire mill.

According to the Trade and Navigation returns, the exports of aluminium in bars and blocks, from Canada, during the twelve months ending December 31st, 1914, totalled 14,549,600 lbs., valued at \$2,157,720. This is mainly exported to the United States and to Great Britain.

GRAPHITE.

Only one return of shipment of graphite was received at the Quebec Mines Branch. This was produced by the Quebec Graphite Company who are operating on lots 1 to 5, range IV,

(1) "The Mineral Industry 1905".

(2) "Economic Minerals and Mining Industries of Canada, 1914".

Buckingham township. None of the other mills, of which there are five, were re-opened in 1914.

The deposit which is being worked by the Quebec Graphite Company is composed of a chloritized rock, very graphitic, lying between well defined gneisses on the south-east and crystalline limestone on the north-west. The width of the workable ore varies between one foot and fourteen feet. The average contents of the ore mined during 1914, according to Mr. A. Geister, the general manager, was 15.6% graphite. The general trend of the deposit is N. 30° E.

The main workings, as well as the mill, are on lot 5. There are several open cuts, and two shafts 310 feet apart, one 65 feet deep, and the second 70 feet. Drifts from both shafts were driven along the strike of the deposit, but are yet 50 feet from joining.

The process of concentration is by wet method, and has evolved from long series of experiments and tests. The rock is crushed in a jaw-crusher, then in a ball mill, and lastly in a tube mill. The crushed material is classified in spitzkasten, then separated on Krupp-Ferraris tables, of which there are 16. The water of the concentrated graphite is first extracted by vacuum, in a large cylindrical vessel on trunions, with bottom of filter-cloth. It is then shovelled on trays, set in tiers on wheels and pushed into an oven to dry.

From the dryer, the graphite goes through a polishing machine. The graphite thus obtained is said to contain no mica scales, the ash being practically all silica.

The power of the plant is furnished by a Diesel oil engine of 160 h.-p., which burns crude petroleum.

That deposits of disseminated graphite can be worked successfully, has been proved by the development of the Madagascar graphite industry. In that country, according to the Mining Journal, London, May 9th, 1914, "At the end of 1913 there were in existence 2,427 claims, as compared with 942 at the termination of the year 1912. The total number of metric tons

raised during the past year was not less than 8,000, of which 6,314 tons were exported, which is more than double the production of 1912. The exportation of graphite commenced with 19 tons in 1909, which was increased to 545 in 1910 and to 1247 in 1911. The best qualities contain from 90 to 97 per cent of carbon."

In his work, entitled "*Les Richesses Minérales de Madagascar*" (published in 1912 by Dunod et Pinat, Paris), Mr. D. Levat states that on the island of Madagascar, the graphitic gneisses form a belt of 40 kilometers radius surrounding Tananariye. The natives work exclusively on the decomposed outcrops which are easily handled with pick and shovel without explosives. This decomposed material contains approximately 10% graphite in disseminated scales, but owing to their crude methods, it takes 20 tons of it to produce one ton of graphite.

The ore is roughly concentrated at the mines by washing, and the resulting material containing about 65 per cent carbon is taken, usually by canoes, to a concentrating mill.

Since Mr. Levat wrote this report, great improvements have taken place in the methods of exploitation and transportation, and now Madagascar is becoming a very important producer of graphite.

CHROME.

The chrome ore which figures in the table of production represents shipments from stock on hand, for no mining for chrome was done during 1914.

The exploratory work undertaken by the Black Lake Asbestos and Chrome Co. does not seem to have been followed up by mining operations.

Until 1908, the chrome deposits of Coleraine township were actively worked, but the discovery of the Rhodesian deposits and renewed activity in the New Caledonian mines seem to have had a bad effect on the chrome industry of the Province of Quebec.

At present the world's supply of chrome ore comes from Rhodesia and New Caledonia, which, according to the "Mineral Industry", produced about 63,000 tons each in 1913. The Home Office report on Mines and Quarries gives the production of Rhodesia for 1912 as 62,832 metric tons, valued at £154,600, and of New Caledonia, for the same year, at 42,000 tons, valued at £50,480. The last years of chrome mining in the Coleraine district were 1904 to 1908. In 1906, the highest production was reached of 8,961 tons, valued at \$91,834.

In December, 1914, the mine of the Dominion Chrome Company at Black Lake was leased by Mr. Aurèle Paré, of Coleraine, who intends to mine and ship chrome ore in the spring of 1915.

The following information regarding the Quebec occurrences of chromite is reproduced from Mr. Dresser's report on the serpentine and associated rocks of Southern Quebec, published by the Geological Survey of Canada, 1913 :—

"Chromite, or chromic iron, is an oxide of chromium and iron, which is valuable, not as an ore of iron, but chiefly for its content of chromium, an element that is used in certain important chemical and metallurgical processes. It is found in this district in irregular or lense-shaped bodies of workable size and also in nodules and grains which are widely disseminated through the serpentine and pyroxenite.

The output, hitherto, has been obtained from the district between Thetford Mines and D'Israeli, Chrome Siding, near Black Lake, being the principal shipping station. Smaller shipments have also been made at Thetford Mines and D'Israeli.

Promising deposits have, however, been long known to exist at many places in the serpentine belt of Southern Quebec. Many of these, doubtless, only await transportation facilities and other market conditions to bring them into use. Important occurrences have been reported from the townships of Bolton, Orford, Melbourne, Ham, Ireland, Leeds, Wolfestown, Coleraine and Thetford, and as far north as Mount Albert, in Gaspé.

PRODUCTION.

The following are the annual returns of production from 1894 to 1909, inclusive :

	Tons	Value
1894	1,000	\$20,000
1895	3,177	41,300
1896	2,342	27,004
1897	2,637	32,474
1898	2,021	24,252
1899	2,010	21,842
1900	2,335	27,000
1901	1,247	16,744
1902	900	13,000
1903	3,509	51,121
1904	6,074	67,146
1905	8,575	93,301
1906	9,035	91,859
1907	7,196	72,901
1908	7,225	82,008
1909	2,470	26,604

A part of these ores is used by the Electric Reduction Company of Buckingham, Quebec, in the manufacture of ferro-chrome. Except for occasional small shipments to Europe, the remainder—more than three-fourths of the total production—is shipped to the United States. It is there used in the manufacture of bi-chromates for use in dyeing textiles, tanning leather, for pigments used in printing and painting, in making chrome steel, and lower grades for lining furnaces.

CHARACTERS OF THE ORE.

Chromite occurs in the rock in varying proportions, from masses of pure ore to disseminations in the country rock too poor to be used as ores. The value depends on the amount of oxide of chromium, Cr_2O_3 , which the ore contains. Ores carrying 45 per

cent or more of chromic oxide are put into the market as crude ore. Ore falling below 50 per cent, however, is penalized, and that running above 50 per cent is at a premium of 50 cents to \$1 per unit per ton. Ore carrying less than 40 per cent and as much as 10 per cent is concentrated to 50 per cent or more. It is, therefore, important to secure as high a grade of product as possible, the grade depending on the completeness of the separation of the ore from country rock, and of the proportion of chromic oxide originally contained in the ore.

Theoretically, chromite consists of one molecule of ferrous iron and one of chromic oxide. But it is known that the iron may be replaced by a certain proportion of magnesium, and the chromium to some extent by aluminium. Accordingly Pratt (Op. cit.) has suggested that chromite is probably an isomorphous mixture of FeO , Cr_2O_3 ; MgO , Cr_2O_3 ; and MgO , Al_2O_3 .

Diamonds.—In view of the recent discovery of diamonds by Mr. R. A. A. Johnston, Mineralogist of the Geological Survey, in rocks containing chromite which were found by Mr. Chas. Camsell in the Tulameen district, British Columbia, specimens from Black Lake were handed Mr. Johnston for examination. Four specimens were taken. One was of chromite ore from the Montreal pit of the Dominion Chrome Company, now the property of the Black Lake Consolidated Mining Company; one of serpentine from the vicinity of the ore body, and one of vesuvianite from the same pit. The fourth specimen was a piece of peridotite taken near Black Lake station. The last three specimens contained no diamonds, but the specimen of chromite ore was found to contain about 0.06 per cent of diamonds, which are small but otherwise of good quality. The diamonds found are too small to be of commercial value as gems. Nevertheless their occurrence is important, as the examination of a single specimen is by no means a complete test of the whole deposit or of the chromite of the entire district. Forty-five localities in which chromite is found are shown on the accompanying map of the Thetford-Black Lake district, and many others are known farther to the southward. The examination of these, as well as further testing of the deposit at the Montreal pit, and an examination of

the gravels in the vicinity of any of the deposits where this is practicable, is necessary before it can be safely told whether or not the diamonds are of commercial importance in the district.

The following is Mr. Johnston's description of the process he employed in extracting the diamonds and of the results attained :

'Examination of specimens from the vicinity of Black Lake, Quebec, with a view to ascertaining the presence or absence in them of any form of diamond, by R. A. A. Johnston :—

"No. 1.—This specimen consisted of a massive, shiny black, somewhat granular chromite, more or less intimately mixed with some greyish serpentinous material."

"A fragment was broken from this specimen and crushed to a powder passing a sieve of sixty meshes to the linear inch ; this powder was then treated in a separatory tube with Thoulet solution of a specific gravity of about 3.0 ; the heavier separate which settled at the bottom of the tube weighed after washing and drying approximately 11 grammes ; this was mixed with 50 grammes of chemically pure dry carbonate of soda and the mixture fused in a large platinum crucible at a cherry red heat for four hours ; after cooling the melt was digested in distilled water to complete disintegration, the supernatant liquid filtered off and the residue treated with hydrochloric acid to remove oxides of iron, magnesium, etc. About half of the chromite was removed in these operations. This course of procedure was repeated several times. It soon became evident that this method was of little effect upon the coarser particles of chromite that were being left after each set of operations ; fusion with bisulphate of potassium was then resorted to, and the residue from this treatment which showed a number of minute diamonds along with some undecomposed chromite was freed from the latter by a final fusion with sodium carbonate."

"The residue of diamonds obtained in the manner indicated above was found to weigh nearly seven milligrammes or 0.06 per cent of the heavy separate operated upon, which constituted nearly the whole of the specimens."

"These diamonds appear to the naked eye as nothing more than dust particles ; under the microscope, however, with a mod-

erate power, they are seen to be perfectly transparent and beautifully crystallized; the most common form is that of the simple octahedron; many of them though, are apparently combinations of the cube and octahedron. The hardness could not be determined with accuracy owing to the very small amount of material available for experiment, but in the course of their removal from a beaker with the aid of a camel's hair brush, it was noted that even such light pressure as was occasioned in this way was sufficient to cause abundant fine scratches upon the glass."

"When exposed to radium emanations they can be seen to fluoresce distinctly, a test which is regarded as conclusive evidence of the character of the mineral."

RELATIONS TO THE COUNTRY ROCK.

It is a striking feature of the occurrence of chromite, that it is found in greater or less amount throughout the entire peridotite and serpentine belt. In parts of the rock not occupied by ore bodies, nodules of chromite are occasionally found, and grains of the mineral are more or less freely scattered through the entire rock. This general dissemination of the chromite, together with the highly altered condition of the rocks at first, seemed to suggest that the ore bodies had been formed by a concentration of the mineral from the surrounding rock, but further examination does not support this view.

The ore bodies do not commonly have well defined walls, and grains of chromite are quite as plentifully disseminated through the rock adjacent to the ore bodies as elsewhere. In fact, except where there has been faulting or slipping, the ore bodies generally pass by gradation into lean ore, and thence into chromite-bearing rock too poor to be worked.

The ore bodies are generally irregular in shape, though they commonly have an approach to ellipsoidal outlines in the surface section, indicating that they are more or less lense-shaped. In such cases the longer axes lie parallel to the general foliation of the country rock, that is N.E.-S.W., and so the form may be the result of regional pressure which has taken place after the ore bodies were formed.

One of the largest bodies of ore yet proven is at the No. 1 pit of the Black Lake Chrome and Asbestos Company. This ore body is some 80 feet in length, from 5 to 50 feet wide, and has been worked to a depth of 340 feet. It dips to the west at an angle of about 60° . In its general form this ore body appears to be quite similar to the famous Wood mine, of Lancaster, Pennsylvania, which was one of the first chromite mines to be worked in America. This was first described by Prof. Frazer¹ as follows :

“The country rock is serpentine. The ore body as proven is almost 50 fathoms long at its greatest extension. Depth proved to 120 fathoms. Pitch of the mine from 40° to 60° under the horizon. The width of the ore bearing rocks is from 10 to 35 feet, or may be taken generally at 20 feet.”

The Montreal pit of the Dominion Chrome Company is another of the larger deposits. Here the work has been done chiefly by an open-cut of 100 x 40 feet, with a maximum depth of 60 feet. The original ore body, which dips towards the northwest at a low angle, has been followed all the way. It was 15 feet thick at the surface, and maintained that thickness at different places. Where this has been removed, several bore-holes have been sunk to test the underlying rock. The logs of two of those holes are given below. The hole A is a vertical one, that at B dips northwest at 60° . This is the direction of the dip of the ore body, but at a considerably higher angle. The holes begin at practically the same place.

A.	B.
0-43 feet serpentine.	0-47 feet serpentine.
43-46 " ore.	47-50 " ore.
46-55 " serpentine.	50-51 " serpentine.
55-58 " ore.	51-59 " ore.
58-74 " serpentine.	59-63 " serpentine.
74-80 " ore.	62-63 " ore.
80-82 " serpentine.	63-65 " serpentine.
82-83 " ore.	65-73 " ore.
serpentine.	73-83 " serpentine.
	83-84 " ore.
	84-88 " serpentine.
	88-98 " ore.
	serpentine.
Total ore, 13 feet.	Total ore, 31 feet.

¹ Second Geological Survey of Pennsylvania, 1880

Some portions of the rock, classed as serpentine in the above logs, are granite; but their measurements are not distinguished. Boring B being nearly parallel to the dip of the lenses, shows the dimensions along the axes nearest to the vertical, which appear to be approximately two and a half times the thickness of the ore bodies.

The Caribou pit (locality 37 on the accompanying map of Black Lake mining district)*, of the Black Lake Chrome and Asbestos Company, shows some features of interest, although the removal of the rock between the ore bodies, as well as the ore, leaves little to show the relations of the original deposit. At present it is a pit 90 feet deep, showing small lenses of rich ore on either side. There is a wall of granite on the southeast and northwest sides. On the southwest side the granite is a dyke 8 feet thick, on the opposite side about 2 feet thick, and less regular. The ore at present seen is near, but not touching the granite walls. Isolated bodies of ore are said to have been found between the dykes, and the amount of rock removed would certainly indicate that some values must have been obtained in various parts of it. The history of the working before the property fell into the hands of the present owners could not be ascertained, but the best ore seems to have been near the sides of the present pit. Molybdenite occurs in small quantities with the chromite at one place in this pit.

The Canadian Chrome Company's mine (locality 32 on accompanying map 23A)* is an open pit, of somewhat similar extent to the last. In the central part of the northeast wall a body of granite, some 10 feet in width at the surface, extends downward vertically for 30 feet, and is then replaced by serpentine. It is one of those places in which the granite has the appearance of being contemporaneous with the peridotite from which the serpentine has been formed. The best ore seems to have been obtained near the western side of this pit. The ore body of this property appears to be less well defined than usual, but practically all the serpentine near, and for a considerable distance to the northeast of the main pit, is impregnated by chromite, furnishing a very large amount of low grade concentrating material.

* These refer to map accompanying Report by J. A. Dresser, Geol. Surv. of Can.: from which the quotation is taken.

The mine of the American Chrome Company (localities 14, 15, etc., on accompanying map 23A)* is essentially similar to the above in its development, and the ore occurs as disseminations in the rock for a very considerable distance about the mine.

The property of H. Leonard (localities 3, 4, 5, on accompanying map 23A)*, near Breeches lake, appears to be similar to those mentioned in the relations of the deposit to the country rock, but the deposit is not well developed. It shows a considerable amount of good ore, exposed in three cuttings, one of which is 100 feet in length. The others are respectively 100, and 500 feet distant. The ore appears to be 5 or 6 feet in width at each of these places, and the covering of drift and talus on the surface makes it impossible to say how closely these different exposures of ore can be traced together. They lie in succession in a south-westerly direction from the larger pit.

The numerous other mines and prospects of the district are worked by open-cut, and this fact, with the smaller development, makes it difficult to obtain definite evidence of the shape, or relation of the ore bodies, except in sections exposed on the surface. There appears to be no definite order of succession in these ore bodies, but they are separated by masses of the country rock, in some cases a few inches, in others many feet in thickness. While their distribution is irregular, they seem to occur most frequently in a zone of the country rock parallel to and not far distant from its contact with the adjacent sediments.

MINING.

Mining is carried on in open-cuts, except at the Black Lake pit No. 1, where a shaft has been sunk. As the ore bodies are often small and discontinuous, the least expensive methods of working have usually been adopted. Power drills and derrick hoists are the principal equipment used. The diamond drill has been used successfully for prospecting.

Concentration.—The ore is bought and sold on a basis of 50 per cent chromic oxide. If higher than this, a premium is paid; if lower the ore is penalized. Consequently ore carrying ap-

* See foot note page 38.

proximately 45 per cent is shipped as crude ; all from that quality to about 10 per cent is concentrated to 50 per cent or a little higher. The highest percentage reached in either crude or concentrated ore is rarely above 55 per cent Cr_2O_3 .

The method of concentration that has been followed recently, consists, successively, of crushing, stamping, and concentrating by means of Wilfley tables. The middlings from the first Wilfley are usually treated on a second table, and a product rarely exceeding 51 per cent is obtained. No data is at present at hand as to the percentage of recovery. There is, however, an apparent loss in 'float', or very finely crushed ore, which is carried from the tables with the lighter rock particles.

OCCURRENCES OF CHROME IRON ORE.

1. Garthby,	range V, lot 36,	O. Brousseau.
2. "	range V, " 37.	O. Brousseau.
3. "	" I, " B.	Gosselin.
4. "	" I, " C.	H. Leonard & Co.
5. "	" II, " 5, 6, 7, 8,	H. Leonard & Co.
6. "	Breeches lake,	H. Leonard & Co.
7. "	range II, N. lot 4.	M. J. Hawley.
8. Ireland	" II, lot 28,	King Bros.
9. Coleraine, block	A,	Black Lake Chrome & Asbestos Co.
10. "	" A,	" "
11. "	" A,	" "
12. "	" A,	" "
13. "	" IV, lot 7,	American Chrome Co.
14. "	" IV, " 8,	" "
15. "	" IV, " 9,	" "
16. "	" IV, " 10.	" "
17. "	block, A,	Black Lake Chrome & Asbestos Co.
18. "	" A,	" "
19. "	" A,	" "
20. "	range X, lot 19 N. W.	James Reed.
21. "	block A,	Black Lake Chrome & Asbestos Co.
22. "	" A,	" "
23. "	range X, lot 9.	James Reed.
24. "	block A,	Black Lake Chrome & Asbestos Co.
25. "	" A,	" "
26. "	" A,	Standard Asbestos Co.
27. "	" A,	Black Lake Chrome & Asbestos Co.
28. "	" A,	Standard Asbestos Co.
29. "	" A,	Black Lake Chrome & Asbestos Co.
30. "	" B, lot 23,	Union Mine.
31. "	range B, " 26,	Ward and Ross.
32. "	" A, " 16,	Canadian Chrome Co.
33. "	" A, " 17,	J. Lemelin.
34. "	Ind. Res. range XIII, L. 8.	Star Chrome Mining Co.
35. "	range IV, lot 25,	F. E. Narges.
36. "	" XIII, " 5, Ind. Res.	Star Chrome Mining Co.
37. "	" III, " 25,	A. Boudreau.
38. "	" II, " 25,	Dominion Chrome Co., Montreal.
39. Wolfestown,	ranges II and III, lot 24.	Bell Asbestos Co.
40. Coleraine, block	A,	Black Lake Chrome and Asbestos Co.
41. Garthby,	ranges I and K.	
42. Coleraine,	" IV, lot 4,	Adam and St. Onge.
43. "	" A, " 15,	
44. "	" B, " 13,	American Chrome Co.
45. "	" XIII " 2,	R. H. Gardiner.

The obstacles of most importance in the operation of the chromite mines are the comparatively small size of individual ore bodies, and the necessity of concentrating much of the ore. These difficulties are general, and apparently apply to chromite mining in most other countries. While the mining of a single lens of ore may be highly profitable, the amount of dead rock to be passed through before reaching another is a very uncertain factor. In some places one ore body is separated from another by only a few inches of rock; in others, by many feet. Consequently, it is difficult to obtain a regular production from a single pit except in the larger bodies, and in all cases ample exploratory work is necessary.

Much of the district seems to have been only superficially prospected and thorough detailed work is likely to extend the discoveries of the mineral, especially to the south of the area embraced in the accompanying map. In view of the natural advantages of location and means of transportation, it is safe to conclude that many of the deposits already known will shortly be further worked and that new developments will be made from time to time. Moreover, should the utilization of slightly lower grades become feasible, immense quantities of ore could be put in the market from this field.

GOLD AND SILVER.

Gold figures in our table of production for \$21,064 and silver for \$31,809. A small proportion of the gold was produced by individual miners, from the alluvial deposits of the Beauce district, but the bulk of the gold and silver production is to be credited to the pyritous ores of the Eastern Townships.

The hydraulic workings of Champs d'Or Rigaud-Vaudreuil, in Beauce, have not been operated since 1912.

Some development work was done during the first part of the year, on several of the claims which were staked out on auriferous lodes, in 1911 and 1912, on the shores and vicinity of Kienawisik Lake, in Dubuisson township, but none of the deposits have as yet produced.

The deposits, which were described in the Report on Mining Operations in the Province of Quebec in 1912, by Dr. J. Bancroft, consist of quartz veins carrying gold.

The claims on which most work has been done so far are the Sullivan group of claims and the Clowes properties. The Sullivan claims are situated on the east shore of lake Kienawisik and comprise parts of lots 47 to 51, range IX, and part of 53, range X, of Dubuisson.

The Clowes properties on which a shaft 26 feet deep is said to have been sunk, as well as much trenching done, are situated some three miles south of the Sullivan claims, and comprise parts of lots 46 to 52 in ranges VI and VII of Dubuisson township.

IRON.

Iron ore mining was at a complete standstill during 1914. The Canada Iron Corporation, which went into the hands of a receiver in 1913, has been taken over by the Canada Iron Foundries, Ltd., but none of their plants in the Province of Quebec resumed work.

There were no shipments of titaniferous ores to Niagara Falls in 1914. Presumably the ore which was shipped to the Titanium Alloy Co. in 1912 and 1913 was sufficient to carry them over 1914.

MINERAL PAINT.

The production of iron oxide and ochre in 1914 was valued at \$36,600, a slight decrease as compared with the production in 1913.

A part of this material is used in the manufacture of paint and the balance is employed by gas works in the purification of the gas.

Although deposits of iron oxide and ochre are numerous in the Province of Quebec, the only ones worked are situated on the north shore of the St. Lawrence river, immediately below the city of Trois-Rivières. These are all surface deposits and the material is calcined at the mine. The iron oxide thus produced

is high grade and most of the calcined material contains over 90% ferric oxide.

MOLYBDENITE.

The European war has created a very keen demand for molybdenite, and the prices of this mineral have risen steadily since the beginning of hostilities. Towards the end of the year 1914, molybdenite was quoted \$2,000 a ton for 92 to 95% material, whereas two years ago it was \$600 a ton. Quotations in the early months of 1915 are said to have reached \$2,500.

“(1) The chief use to which most of the world's molybdenum is devoted is the preparation of special varieties of steel..... Molybdenum steel is used for rifle barrels, propellor shafts, large guns, wire, and particularly for the manufacture of high speed tools. Molybdenum high speed steel contains from 8 to 10 per cent molybdenum. When the other elements exist in the right proportion, a steel is obtained of great hardness, with the peculiar property of retaining its temper when heated to a high degree, differing in this respect from all carbon steels. Owing to this property, it is possible to take extremely heavy cuts at high speed, the tool often being heated through this hard use to a dull red heat without impairing its usefulness.”

Deposits of molybdenite are known in Northern Quebec on lake Kewagama in La Motte and La Corne townships. These were described in the reports on Mining Operations in the Province of Quebec for 1911 and 1912. The great difficulty encountered in the exploitation of these deposits has been the problem of concentration, as the molybdenite is found disseminated throughout the rock in a very irregular manner.

Several other occurrences, at Manicouagan, at Olomanoshibo, both on the north shore of the Gulf of St. Lawrence; in Egan, Alleyn, Aldfield townships; on Calumet Island, are described in the report by Dr. T. L. Walker “Molybdenum Ores of Canada”, published by the Department of Mines, Ottawa.

“(1) Molybdenum Ores of Canada ” by T. L. Walker, Dept. of Mines, Ottawa.

During the year 1914, some development work was done by Mr. Charles Higgerty, of Ottawa, on a deposit of molybdenite situated in Eardly township, on lot 6, range XI. A vein is said to have been uncovered for a distance of 200 feet, and a few hundred pounds of molybdenite is said to have been produced from preliminary work.

The question of separation of the molybdenite from the gangue has not yet been satisfactorily solved for ores of low contents in molybdenite. In this connection it is interesting to quote extracts from the Summary Report of the Mines Branch, Department of Mines, Ottawa, for 1913, regarding experiments effected in the Metallurgical laboratories of the Mines Branch, on the concentration of molybdenum ores :

TEST No. 1.

MOLYBDENUM ORE.

“A small shipment of 200 pounds of the ore was received from Mr. C. G. Ross. It was taken from the surface workings on lot 16, con. XI, township of Brougham, Renfrew county, Ontario.

The ore consists of molybdenite associated with pyrrhotite and pyrite in a pyroxenite and actinolite gangue. A small amount of mica, quartz and calcite are also present. Between the laminæ of the molybdenite are found embedded small crystals of pyrrhotite and pyrite.

The crude ore was crushed in the jaw crusher set at $\frac{3}{4}$ " opening. After a rough hand-cobbing, it was passed through rolls set at $\frac{1}{4}$ " opening. The product from this crushing was screened on a 3-mesh Sturtevant screen. The over-size was passed through the rolls and screened on the 3-mesh screen. This operation was repeated three times, resulting in a high-grade molybdenite concentrate remaining on the screen. The physical character of the ore permits the crushing of the gangue material to pass through the screens, while a large percentage of the molybdenite particles are flattened out and remain on the screen.

The material through 3-mesh was screened on a 4-mesh Stur-

tevant screen and the above operation repeated. These successive screening and rolling operations were conducted on the material on the 6, 8, 10, 12 and 20-mesh screens.

The following high-grade concentrate was obtained :—

Hand cobbled	1 pound, 9 ounces
Caught on 3-mesh screen	0 “ 11 “
“ “ 4-mesh screen	0 “ 8 “
“ “ 6-mesh screen	0 “ 13 “
“ “ 8-mesh screen	0 “ 7½ “
“ “ 10-mesh screen	0 “ 4 “
“ “ 12-mesh screen	0 “ 5½ “
“ “ 20-mesh screen	0 “ 11 “

A total of 5 pounds, 5 ounces

The tailing resulting from the above concentration was sized on 30, 40, 50, 60, 80 and 100-mesh screens, and the sized products were passed through the Huff electrostatic separator, to obtain a separation of the molybdenite remaining in the tailing from the gangue by this process.

A good separation was not effected. The other sulphides were drawn over by the electrode to a considerable extent. In order to clean these concentrates, rolling and screening was found necessary.

RESULTS OF TEST.

Crude ore treated	195 pounds.
Concentrate obtained	7 pounds, 7½ ounces.
Analysis of concentrate.....	82.73% MoS ₂ , or 49.63% Mo.
Recovery	63.06%.
Loss in tailing	36.93%.
Analysis of crude ore.....	5.02% MoS ₂ , or 3.01% Mo.

TEST No. 2.

Two shipments of ore : one of 100 pounds and the other of 250 pounds, were received from the Renfrew Molybdenum Mines, Mount St. Patrick, Ont. The ore was obtained from the mine

workings, situated on lot 8, con. XI, township of Brougham, county of Renfrew, in the Province of Ontario.

The ore is similar to that described in test No. 1. The molybdenite was found to be associated with pyrrhotite and pyrite, in a pyroxenite and actinolite gangue. Small amounts of quartz, calcite and mica were also visible in the gangue material.

The crude ore was crushed in a jaw-crusher set at $\frac{3}{4}$ " opening, screened on a 2-mesh Sturtevant screen, the over-size crushed in rolls set at $\frac{3}{8}$ " opening. The following screening products were obtained:—

	2-mesh	.....	7 pounds, 12 ounces
2 +	4-mesh	.....	108 " 12 "
4 +	8-mesh	.....	44 " 9 "
8 +	16-mesh	.....	32 " 10 "
16 +	30-mesh	.....	30 " 8 "
30	mesh	.....	24 " 0 "

A total of 248 pounds, 3 ounces

The sized products were rolled and screened on their respective mesh five consecutive times, the rolls being adjusted for each crushing. The material passing through the screens was sized and added to the above sized products. From this operation a high grade concentrate of 9 pounds $31\frac{1}{2}$ ounces was obtained.

Analysis of the concentrate showed it to contain 85% MoS_2 . A recovery of 77% of the molybdenite values was obtained. The loss in tailing was 23% of the molybdenite values. An analysis of the crude ore was not made, but from the analysis of the concentrate and tailing, it was found to contain 4.3% MoS_2 ."

MICA.

Returns of shipments of mica were received from thirteen producers, who valued their sales at a total of \$67,278. This is a decrease of \$49,760 as compared with the previous year.

From all the producers comes a unanimous expression that the

declaration of war affected the mica market very adversely. During the first six months of the year the prices were satisfactory and the demand was good, but within a short time after the commencement of hostilities, the demand fell to practically nothing, most of the mica mines shut down entirely, and the producers who had to sell their mica did so at a loss.

The following table gives a comparison of the average prices which prevailed for mica in May and in December respectively, 1914:—

Size	Average prices in May	Average prices in December
1 x 1 inches.....	6c. per lb.	3 to 4
1 x 2 "	10 to 12	6 to 8
1 x 3 "	20 to 25	12 to 14
2 x 3 "	40 to 50	30
2 x 4 "	65 to 75	50
3 x 5 "	75 to 90	65

Mica in District of Quebec City.—In previous years the mica industry was practically confined to the region of the Gatineau and Lièvre rivers, but in 1914, substantial quantities of excellent mica were shipped from a mine situated some eighteen miles below the city of Quebec, at Petit Pré, about two miles inland from the St. Lawrence river.

This mine, owned by Mr. Louis Richard, of L'Ange Gardien, is in a belt or dyke of green, rather even-grained, pyroxenite, very similar to the rock which characterizes the mica deposits of the Lièvre-Gatineau region. The mica occurs in a vein which starts at the surface, with a general strike nearly north and south and having on the west side a rather ill-defined gneiss. The vein itself is entirely in the rather granular pyroxenite. It is narrow at the surface, but widens considerably in depth. At 30 to 35 feet from the surface, a width of 8 to 10 feet is practically entirely made up of black mica. The lower level of the pit is said to be at 65 feet, but was flooded when visited. The mica, showing at the bottom, is reported to be abundant and of good quality. The pit is about 75 feet long, along the strike of the vein, and

the deposit has on the whole a very good appearance. The mica is rather dark, and in places the vein is crushed, which is liable to develop flaws in large sheets of mica, but, nevertheless, a large quantity of very good material has already been extracted, part of which has been shipped, and the balance is in the sheds.

A well-equipped plant has been put up at the mine, consisting of cable-derrick, hoist and boiler substantially housed, as well as sheds.

This occurrence is, moreover, very interesting as being the first mica mine worked in the region of Quebec city, and as revealing the existence of a pyroxenite belt. According to H. de Schmid, "The pyroxenites. occur principally in the form of narrow belts, often interposed in the form of what may be termed pyroxenitic zones in the gneisses and limestones. That is, a number of more or less parallel belts are often observed at short distances from one another separated by a narrow band of gneiss or limestone; while once such a zone is passed, a considerable extent of country may have to be traversed before other similar rocks are encountered."

It is therefore probable that this pyroxenite occurrence, which has given rise to the Richard mine, is not an isolated one, and that further prospecting in the vicinity might easily be rewarded with other valuable discoveries.

NATURAL GAS.

A marked renewal of interest in the possibilities of Natural Gas in the Province of Quebec took place during 1914, and at present two companies are putting down wells in the vicinity of St. Hyacinthe. They are "The Canadian Natural Gas Co." and "The National Gas Co."

Under these circumstances it may be opportune to give a short summary of what has been done in the past and add to it the data obtained by the new bore holes put down in 1914.

The presence of natural gas in the Paleozoic rocks which underlie the Laurentian lowlands has been known for a very long

time, and as far back as 1863, mention is made that "The light carburetted hydrogen, or marsh-gas..... is abundant in the paleozoic rocks of Canada, and issues from numerous springs. Those of Caledonia, Varennes and Caxton..... give off great volumes of this gas, which keep the waters in constant agitation. Many other less important instances of the same kind might be mentioned; while in the higher strata of Western Canada (Ontario) this gas is still more abundant, as at the well-known boring springs near Niagara Falls, and in the region of the oil wells. In boring these, reservoirs of it are frequently penetrated, from which the gas is liberated with explosive violence." (*Geology of Canada*, 1863).

Although natural gas had been put to commercial uses in New York State as early as 1821, yet for a very long period the presence of natural gas in the Province of Quebec was regarded mainly as an indication of the presence of petroleum, as will appear from the following extracts reproduced from old official reports:

"In the districts about Three Rivers, that is, in the south part of the counties of Champlain, St. Maurice, Maskinongé, Berthier, Joliette, some very considerable emanations of combustible gas have been noticed ever since the country has been inhabited. The places where these have been known to occur are at St. Maurice, Pointe du Lac, Louiseville, St. Léon, Epiphanie, St. Paul l'Hermite, St. Henri de Mascouche, etc., and on the south shore at St. Grégoire, county of Nicolet. This gas has certainly an origin which should be found in petroliferous deposits in the underlying rocks. It therefore seems rational to suppose that there exist large quantities of petroleum from which the gas is continually being formed." (J. Obalski, in *Report of Commissioner of Crown Lands for 1884*).

In the same report, Mr. Obalski gives the following account:—

"The emanations of gas which I visited occur on the south-east part of the Beauséjour concession in the Seigniorship of Roquetaillade, on the land of Mr. Hilaire Trudel (cadastre No. 501), and on that of Mr. Moise Houle (cadastre No. 500).

Almost eight arpents south-east of the concession road, and parallel to it is a patch of land of some four arpents in length, from which combustible gas arises. The soil is composed of clay and sand for a depth varying from fifty to sixty feet. From all the borings made down to the hard rock, gas escaped in great abundance. At the centre of lot 501, a hole some fifteen feet deep had been dug and had become filled with rain water. In this had been placed a barrel, open at one end, with a gun-barrel fitted into the other. The gas escaping from the gun-barrel has been burning since January of this year, with a flame more than a foot high. A small well has also been sunk on No. 500, from which gas escapes incessantly. At other points an ordinary barrel is filled in a very short time. I caused some soundings to be made in my presence with iron rods about half an inch in diameter, and found what is indicated in the accompanying sketch, viz: in great part a bed of clay overlying a thin layer of black sand, which in turn rests upon hard rock, which according to the geological map, should be the upper schist of the Trenton formation. The protocarbonated hydrogen gas is similar to that which is found on the north side of the river and appears to me to have a similar origin, that is in bodies of petroleum lying below the rocks above mentioned. The contour of the land appears to be irregular, and I would recommend that borings should be made within the belt referred to.

“The proprietors who have been living for thirty years on these lands assured me that they had always been aware of these emanations of gas.” (J. Obalski, in *Report of Commissioner of Crown Lands for 1884*).

“Throughout the whole region comprised between St. Paul l’Hermite, l’Épiphanie and St. Henri de Mascouche, emanations of combustible gas have long been known to occur, often rising from the ground in the company of salt springs. These emanations are similar to those which I have mentioned on several previous occasions, and arise from the same source; that is to say, I believe they are all due to the presence of bodies of petroleum in the subterranean limestone. The conformation of the land and other indications are the same as those at the places previously examined.

“At the place called Cabane Ronde, on the land No. 3 of the cadastre of St. Henri de Mascouche, Messrs. Renaud Brothers and Dubois, began a boring of three inches in diameter. They traversed a bed fifty-four feet thick of blue, yellow and red clay, then sixteen feet of black sand and coarse gravel, and finally struck the schist rock at a depth of seventy feet. During the whole of the time the work was going on, the escape of gas was regular and abundant. Operations were begun in the autumn of 1883, and resumed in the spring of this year. A remarkable circumstance, worthy of being recorded, then occurred. At the beginning of June, on inserting the drill, the workmen met with a resistance which the efforts of four men were unable to overcome, and withdrew the instrument, upon which a violent gush of matter from the opening took place. For forty-eight hours, as I was told by the witnesses of the scene, a column of liquid, gas and stones could be seen issuing to a height of over fifty feet. The gas was of the same character as that previously reported on; the water very salty; and the stones, some of which were half the size of a man’s fist, were composed of quartzites, limestones, black bituminous schists, various kinds of granite, etc., and generally in the shape of rounded pebbles. I was further informed that at the beginning of the discharge, a score or so of oily drops of petroleum were observed to fall, but were not gathered, as it was hoped that a larger quantity would be forthcoming. The boring has since been continued, but more slowly on account of the hardness of the rock.

“These facts are all very important and merit serious consideration, in connection, however, with my previous reports.

“I encouraged the enterprising prospectors to persevere, and it is to be hoped that they will be able to continue their labor in boring to a greater depth, and ultimately see it crowned by a discovery which will be of the greatest importance to the country if a vein of petroleum be struck, as there is reason to expect will be the case.” (J. Obalski, in *Report of Commissioner of Crown Lands for 1884*).

In 1885, a boring was put down on Mr. Hilaire Trudel’s land, Cadastre No. 501, Concession Beauséjour, near St. Grégoire, in

the county of Nicolet, in search of oil. A very strong flow of gas was struck, as the following account states :—

“The following log gives the depths reached and the nature of the rocks encountered :

On the surface, 31st July, 1885, 1 foot of earth, good cultivable soil, flow of odourless gas.

- At 1 ft.— 47 ft. of blue loam with thin layers of sand.
 48 ft.— 5 ft. of blue sand with abundant emanations of odourless gas.
 53 ft.— 15 ft. of heavy gravel composed of pebbles of granite, sandstone, calcareous rock, etc., with abundant emanations of odourless gas and water.
 68 ft.— 7 ft. of black sand, very dense, hard to penetrate, water, but no gas.
 75 ft.— 80 ft. of solid rock, sandstone, somewhat calcareous, soft enough to cut with a knife, oily oozings.
 155 ft.— 60 ft. of same rock, but harder and of a finer grain.
 215 ft.— 75 ft. of red schist, wrongly called by the miners, ““Soap Stone.””
 290 ft.— 10 ft. of same rock, lighter colour.
 300 ft.— 16 ft. of same rock, nearly black.
 316 ft.— 54 ft. of blackish brown schist, not hard, abundant and sudden flow of gas, having a strong smell of kerosene.
 370 ft.—105 ft. of red schist, more abundant emanation of gas.
 475 ft.— 50 ft. of red schist, somewhat greyish.
 525 ft.— 55 ft. of red schist, softer.
 580 ft.— 60 ft. Another flow of gas, more violent, throwing mud and stones from the bottom to a height of 60 feet in the air, and preventing work. This gas affects the sight and the lungs of the workmen. Continuation of red schists.

640 ft.— 20 ft. of impure calcareous rock apparently containing magnesia. Another vein of gas of the same nature.

660 ft.— 60 ft. of calcareous rock.

720 ft.—100 ft. of oily calcareous rock.

820 ft.— 40 ft. of black schist, soft to the touch. New vein of the same gas.

860 ft.—225 ft. of compact black schist.

1115 ft.—Work suspended. The gas continues to flow with such force that it is impossible to close the orifice. So two pipes of $\frac{1}{2}$ inch diameter are fitted to the main one."

"As may be seen, this boring made to find petroleum, has not been attended with the desired result, but it has been discovered that there exists underground an enormous quantity of gas. It has been shown, moreover, that the gas did not emanate from superficial rock, but from the rock itself, and also that it had in these regions a smell of petroleum, establishing the fact that it has rested on liquid hydrocarbons. These results are very satisfactory and tend to strengthen the belief that deposits of petroleum exist there. Are the deposits abundant? Are they more or less near the surface? This remains to be established. Moreover, the combustible gas itself may be utilized for heating and lighting purposes and in metallurgic industries. It may suffice to state that in Pennsylvania, in the town of Pittsburg alone, there are more than 150 companies with a capital of three million dollars who utilize this gas, which is often found at immense depths, from two to three thousand feet. The iron industry employs a great quantity. It was computed that in 1884 in the United States, this gas was substituted for coal to the amount of \$1,460,000 worth of the latter. It has been in use in Fredonia (N.Y.) since 1821, and it is stated that the Chinese have been using it for centuries past.

"From my own estimate, I calculate that the St. Grégoire well discharges about two hundred and fifty thousand cubic feet of this gas every 24 hours, or say seven to eight millions cubic feet per month. The town of Sherbrooke consumes in light one million

cubic feet per month; St. Hyacinthe, three to four thousand. Therefore, it is obvious that the above quantity would be sufficient to light a large town. Besides, this flow has continued for $41\frac{1}{2}$ months. Attempts have been made to stop it by hammering a pine plug into the outlet tube; but at every attempt, the plug was blown up into the air with sufficient violence to split the boards it met in its way.

“It is to be hoped that these works will be continued and that further borings will be made, which, in the event of their not establishing the existence of petroleum in sufficient quantities, would afford the opportunity of ascertaining the great abundance of this combustible gas, and thus lead to the foundation of important industries.” (*J. Obalski, Report Comm. of C. Lands for 1886*).

It is from this date that interest was aroused in the Province of Quebec as to the possibilities of natural gas. This interest was, no doubt, strongly stimulated by the discoveries and utilization of natural gas fields in Ohio and New York States, which were made about that time. The Findlay field in Ohio was piped in 1885.

In the Summary Report of the Geological Survey for 1887, Dr. Selwyn gives notes on the St. Grégoire well as follows:—

“This boring has evidently passed through the Medina shales and sandstones which appear to be here 565 feet thick, and the remainder of the boring, 540 feet, seems to be in the Hudson river rocks. Below these, the Utica and the Trenton would be found, and as it is at the junction of the latter that the main gas and petroleum occurs in north-western Ohio, it seems very desirable that the St. Grégoire boring should be continued till it reaches the Trenton limestone. The Ohio section shows the Medina only 80 feet thick, with 305 feet of Clinton and Niagara on top, and at the base of the Medina there is a heavy flow of gas, as is the case at 640 feet deep, the base of the Medina at St. Grégoire. Below this in Ohio are 430 feet of Hudson River strata and 275 feet of Utica shale, at the base of which, or a few feet lower in the Trenton limestone are, as above stated, the great petroleum and gas reservoirs.

“An all-important consideration in connection with the probable occurrence of these reservoirs is that of the geological structure of the district, and while for reasons in connection with this, I have never had any faith in their occurrence on the north side of the St. Lawrence, I consider that the probability of such reservoirs existing on the south side, in the country between Lake St. Peter and St. Hyacinthe, is very great, especially along, or in proximity to, the central part of the line indicated by Sir W. E. Logan as the course of the Deschambault anticlinal, in the *Geology of Canada*, 1863, pp. 152, 205 and 272.

“At St. Grégoire, 550 feet of Hudson River strata have been penetrated. Between the Island of Orleans and the north shore of the St. Lawrence, Sir W. E. Logan estimated the thickness of the Hudson and Utica at 2,000 and 300 feet respectively. Supposing them to be equally thick at St. Grégoire, the boring would have to be continued 1,700 feet before reaching the Trenton limestone. A little north of St. Hilaire, on the Grand Trunk Railway, however, the Trenton limestone would probably be reached at a much less depth, as the axis of the anticlinal gradually rises in that direction, and the upper measures of the Hudson River and the Medina are absent.

“In any case, the question may certainly be regarded as one of great importance, in comparison with the small amount of money which would be required to thoroughly test it.” (*Geological Survey of Canada, Summary Report for 1887*).

In the Report of the Commissioner of Crown Lands for 1885, is also the following note :—

“*St. Barnabé*.—Whilst sinking a pipe at a depth of 72 feet, a violent flow of gas occurred with a pressure estimated at 38 lbs. to the square inch.

The layers traversed are as follows :

On the surface, 8 ft. of rusty loam.

At 8 ft.—50 ft. of blue loam.

At 58 ft.—14 ft. of fine sand and friable rock.

At 72 ft.— 8 ft. of friable rock, probably schistous, crumbling in the air, easily ignited and as easily cut through as loam. Emanation of odourless gas and water.

At 80 ft.—Hard rock.”

In all probability, this is the occurrence which is referred to further on near which a well was drilled in 1910, on the land of Jos. Fontaine, St. Amable, range No. 164, although the above reference does not clearly specify whether it is meant St. Barnabé, county of St. Hyacinthe, or St. Barnabé, county of St. Maurice.

In the Report of the Commissioner of Crown Lands for 1887, a general review of the situation is given as follows :—

“Natural gas was discovered many years ago in the Valley of the Saint Lawrence, between Quebec and Montreal, especially in the vicinity of Louiseville and Three Rivers. The attention of the Geological Commission was called thereto, but without their attaching any importance to the fact.

“The first work was undertaken before 1880 by Messrs. Piret and Genest, of Three Rivers. At first a well was sunk near St. Maurice to the solid rock, a depth of fifty feet, but the only result was the extraction of a sort of pipe of hardened clay, which may still be seen in the Geological Museum at Ottawa. In 1880, the Reverend Mr. Laflamme read a paper on the subject, at Louiseville, by the light of gas procured in the vicinity, and thus proved the possibility of its being utilized.

“In 1883, Messrs. Renaud Frères and Dubois made a boring to the rock, a depth of seventy feet, on their property (Number 3, of the Cadastre of St. Henri de Mascouche). They obtained a strong flow of gas, but the lack of means compelled them to discontinue their work.

“In 1885, Mr. Poirier, N.P., of St. Grégoire, organized a small company; a boring was effected under favorable conditions on Mr. H. Trudel's property, (Number 501 of the Concession of Beauséjour). The boring was pushed as far down as eleven

hundred and fifteen feet, and a fair quantity of gas was obtained from different depths, as shown in the following statement :

From 0 to 75 feet..... 75 ft.—Clay and sand with some veins of inodorous gas and water.

From 75 to 215 feet.....140 ft.—Sandstone, somewhat calcareous.

From 215 to 640 feet.....425 ft.—Red and brown schists, soft, with abundant emanations of gas, with the odor of kerosene at 316, 370, 580, 640 feet, the 580 feet vein being the most productive.

From 640 to 820 feet.....820 ft.—Impure limestone, oily beneath, a vein of gas at 820 feet.

From 820 to 1115 feet.....255 ft.—Black schist, compact.

“According to the latest information received, the gas is still flowing.

“Soon after these operations, during the session of the Quebec Legislature in 1886, a Canadian company, known as the “Combustible Gas Company”, with Mr. Cyrille Duquet, of Quebec, as President, secured from the Government the exclusive privilege of utilizing natural gas in the Province of Quebec.

“This company made a boring of fifteen hundred feet at Maisonneuve, near Montreal, and three others of five to six hundred feet at Louiseville. These works yielded great abundance of gas, which was even used to heat the Water Company’s steam boiler for some time. Besides, not a month passes without a report being received of gas having been found in digging wells for water.

“In my reports, I have frequently pointed out the importance of these examinations, and in 1884, I even called the attention of the Premier to the subject, pointing out the steps to be taken in the premises.

"An examination of the geological map of the Province will show that the Valley of the River St. Lawrence, between Quebec and Montreal, is formed by Trenton limestone, overlaid by Utica, Hudson River and Medina schists, the whole being covered by a layer of alluvium, averaging fifty to eighty feet thick. At several parts of the North Coast, these formations appear at the surface, but they are more habitually covered with alluvium. We have but slight information as regards the South Shore, where these formations may possibly be covered by other strata. At all events, in the region south of Three Rivers, red schists have been discovered, which apparently belong to the Medina formation.

"The St. Grégoire borings were drilled through similar schists, and, so far, the Trenton limestone has not been reached. The formation indicated on the map, as being that of the south shore, is somewhat hypothetical, owing both to the want of borings, and the thickness of the alluvial layer. It may, however, be stated that the formation, between Quebec and Montreal, which lies visible for some miles on the north shore, and extends over fifty to sixty miles on the south, probably contains gas and petroleum." (*Report Commissioner of Crown Lands for 1887*).

"As stated in last year's report, natural gas occurs in the Trenton formation, which covers a vast triangle, extending from Ste. Anne de la Pêrade and Montreal to the head of Lake Champlain, together with a band of a few miles between the two first named points on the north side of the St. Lawrence. The works executed by the St. Grégoire and Natural Combustible Gas Companies comprise six wells :

1st.—The St. Grégoire well, with a depth of 1,100 feet, bored three years ago, and furnishing an abundant supply of gas, which remains unutilized.

2nd.—Four wells bored at Louiseville, with a depth respectively of 695, 545, 300 and 295 feet, three of which are stopped and one is used to supply heat to the boilers of the Water Works Company.

3rd.—One well, 1,500 feet at Maisonneuve, near Montreal, yielding no more gas—only sulphurous mineral water."

"The examination which I made by geological explorations in the environs of Three Rivers, as well as to the south, shows that, near the city, the rock seems to dip; small borings were made to a depth of 120 feet without meeting it, while it crops to the surface on the south shore of the St. Lawrence and in the concessions a few miles back of Three Rivers. The same remark applies to Louiseville, where at one point, 165 feet of clay and sand had to be bored through before the rock was met. I had a large number of small borings made around Three Rivers without striking the rock, while to the northward, in the parish of St. Maurice, the presence of gas can be easily noted at the surface, by striking the rock at a depth of about 80 feet. I may therefore conclude by stating that, throughout the entire region indicated, there is a chance of finding gas in variable quantities.

"I must add, to the list of places indicated in my preceding reports, l'Acadie, (near St. John's), St. Sulpice, (county of l'Assomption), and St. Barthelemy, (county of Berthier)." (*Report, Commissioner of Crown Lands, 1888, J. Obaski*).

"A new company, "La Cie. de Gaz Naturel de Québec", has been organized to work natural gas and oil deposits in the Province of Quebec, but they have not yet begun boring operations.

"At Nicolet College, a boring was put down through Hudson River and Utica formations to a depth of 1,350 feet, and is being carried down further. It is probable that near the contact with the Trenton limestone, gas or oil will be struck." (*Report Commissioner of Crown Lands for 1895*).

"The Nicolet boring for gas was abandoned at a depth of 2,270 feet, without having struck gas. Trenton limestone was not encountered, although it was thought that it would be met with before reaching this depth." (*Report Commissioner Crown Lands for 1896*).

In 1899, another attempt was made near St. Grégoire, as recorded by Mr. J. Obalski, as follows:—

"During the year, a boring of 685 feet was put down two miles west of the village of St. Grégoire, (county of Nicolet), in the

Pointu Concession. This work was done by Mr. E. Bergeron, who gives the following information: After passing through 35 feet of loam and clay, he struck 25 feet of grey limestone, underlain with red shale, to 655 feet, and then 30 feet of grey limestone with more red shale underneath; at 195 and 240 feet small veins of gas, with oily exudation at 195 feet. At 600 feet, 5 to 6 feet of bluish slate, and underneath, 50 feet of rock yielding very salt water. The boring was stopped without striking gas in merchantable quantity; the rocks traversed seemed to belong to the Medina formation, mentioned by the Geological Survey." (*Mining Operations in the Province of Quebec during 1899*).

Nothing further seems to have been done for several years after, until 1904:—"Boring for natural gas had been given up for many years, but last year, Mr. J. D. Bilodeau, of St. Grégoire, county of Nicolet, organized a company called "The Canadian Gas and Oil Company", which began boring in the Beauséjour range near the old Trudel well opened in 1886, and which, after yielding a good supply of gas, still yields some which is used by the owner for heat and light and also for supplying motive power to a small mill. I would here recall the fact that the Trudel well had been carried down to 1,100 feet, but an abundance of gas was found at about 600 feet, where Medina red schist was struck.

The new company is provided with a good plant and employs trained workmen from Pennsylvania. During the autumn it sank two wells to 814 and 801 feet respectively with a diameter of $5\frac{5}{8}$ inches, which struck red schist at 485 and 450 feet. The latter well is 400 feet south-west of Trudel's. Neither of these wells struck gas and the company suspended work for the winter, but will resume it in the spring, having obtained from the property owners the right to bore over 18,000 acres of land. The wells are on lots Nos. 253 and 157 of the cadastre, the Trudel well being on No. 501.

This natural gas is used in several other parts of the province; amongst others at Yamachiche, Louiseville, St. Barnabé, Ste. Geneviève de Batiscan. Some has also recently been discovered at St. Pierre les Becquets.

At these places, slight borings have been effected by hand through the clay, and the gas issuing from the gravel beds is used for heating and lighting houses.

A certain number of property owners have done this boring, which is inexpensive, and all appear very well satisfied." (*Mining Operations in the Province of Quebec for 1904*).

In his annual report for 1905, Mr. J. Obalski makes the following statement :—

"The Canadian Gas and Oil Company, Ltd., continued boring the wells mentioned last year in the Beauséjour range near St. Grégoire, but without success. One of the two wells in that range has been bored to a depth of 1,200 feet. Another was bored in the Grand Rang to a depth of 500 feet, but without striking gas. The company then bored about fifteen wells at Yamachiche to a depth of 300 feet and found gas in some which is used for supplying residents of the place with light and fuel. Large quantities of salt water were also found which drowned the wells in some cases." (*Mining Operations in the Province of Quebec for 1905*).

The seat of operations of the Company seems to have been moved to the north side of the St. Lawrence River, as the following note indicates :—

"The Canadian Gas and Oil Company seems to have carried on a regular business with the natural gas of the St. Lawrence valley, especially in the Louiseville region. The company reports having bored into the rock to depths of from 180 to 250 feet, and having obtained gas under strong pressure, which is then conveyed by lines of pipes to the neighbouring villages. The company has a dozen producing wells and has laid a line of two-inch pipes two miles long to St. Barnabé, one of three-inch pipes, seven miles and a half in length, to Yamachiche, and one of four-inch pipes, nine and a half miles long, to Louiseville. It is also about to lay a line of eight-inch pipes, thirteen miles long, which will reach Three Rivers about the middle of the summer. The company claims that it can at present sell 300,000 cubic feet of

gas a day, and the prices charged at Three Rivers will be 20 cents per 1,000 cubic feet for public buildings, 25 cents for factories and 30 cents for private individuals. The company likewise proposes to increase their production by means of fresh borings.

“Prospecting for natural gas was tried in the vicinity of St. Hyacinthe, but we are not aware of the results.” (*Mining Operations in the Province of Quebec for 1906*).

In the report for the following year, Mr. Obalski gives the following notes:—

“In July last, I visited the gas wells operated by the Canadian Gas and Oil Co., whose office is now in Three Rivers.

“That company sank a certain number of wells in the vicinity of Louiseville, Yamachiche and St. Barnabé, 13 of which struck gas in merchantable quantities. Those wells begin with a diameter of 6-inch casing and generally strike gas at a depth of from 225 to 300 feet, that is in the neighbourhood of solid rock, which seems, in that region, to be the Hudson River limestone which outcrops opposite Three Rivers on the other side of the River St. Lawrence. They pass through clay, fine sand and gravel of variable thicknesses before striking the solid rock and gas. The company has a boring plant and the work is done very rapidly. It has also sunk some testing wells, among others, one on the Yamachiche river, north of St. Barnabé, some twelve miles from the St. Lawrence. At the time of my visit, it was some 500 feet deep; it began directly on the Trenton limestone, 50 feet of which were pierced, then it met 200 feet of sandstone which seems to me to belong to the Potsdam formation; the remainder is Laurentian gneiss which is found at the northern end of the Trenton basin. This work was abandoned and another testing well begun further south.

“The producing wells are cased and connected with the distributing line. I examined several of these wells and found the pressure good.

“The Company has laid down lines of pipes which supply gas to St. Barnabé, Yamachiche and Louiseville, and in the summer

of 1907, it completed a line of 8-inch pipe, 13 miles long, for supplying gas in Three Rivers. It bought out the old gas company of that city, and laid 6-inch pipes in the streets, which enables it to supply gas for heating and lighting at very low prices, which I mentioned in my previous report. The pressure in the city is reduced to four ounces.

“The gas of this region is very good and is not sulphurous. As to duration, everybody knows that it is surface gas, and I estimate that, in order to find more lasting reservoirs, it will be necessary to bore deeper into the rock and locate the wells towards the south.

“The fact must not be lost sight of that those reservoirs are not inexhaustible; that they should be dealt with sparingly, and preparations should be made for the future in case the gas should disappear.

“In addition to the company above mentioned, private individuals bore with two-inch pipes for their own use at several points in the region and in other parts of the St. Lawrence valley, where gas has been found.

“Prospecting has also been carried on in the vicinity of St. Hyacinthe, and a well has been bored to a depth of 275 feet.” (*Mining Operations in the Province of Quebec for 1907*).

In 1908, the operations of the Canadian Gas and Oil Company were entirely discontinued. Another syndicate, “The Quebec Fuel Company”, was formed, for which Mr. Eugene Coste, a well-known gas authority, was consulting geologist. The following bore holes were put down by this company. The information, although not authoritative, is believed to be correct in the main.

Well No. 1.—On lot No. 566, Parish of Yamaska. Commenced in 1908; stopped in 1909 at depth of 3,060 feet, in shales. Did not reach limestone.

Well No. 2.—In the Parish of St. Roch, on Joseph Perron's farm, county of Richelieu. Drilled in 1909 to a depth of about 2,950 feet; finished in limestone, presumably Trenton.

Well No. 3.—On lot No. 27, Grande Côte, Parish of Verchères, county of Verchères. Drilled in 1909-1910 to a depth of 2,450 feet. Reached Trenton limestone. Struck a little gas.

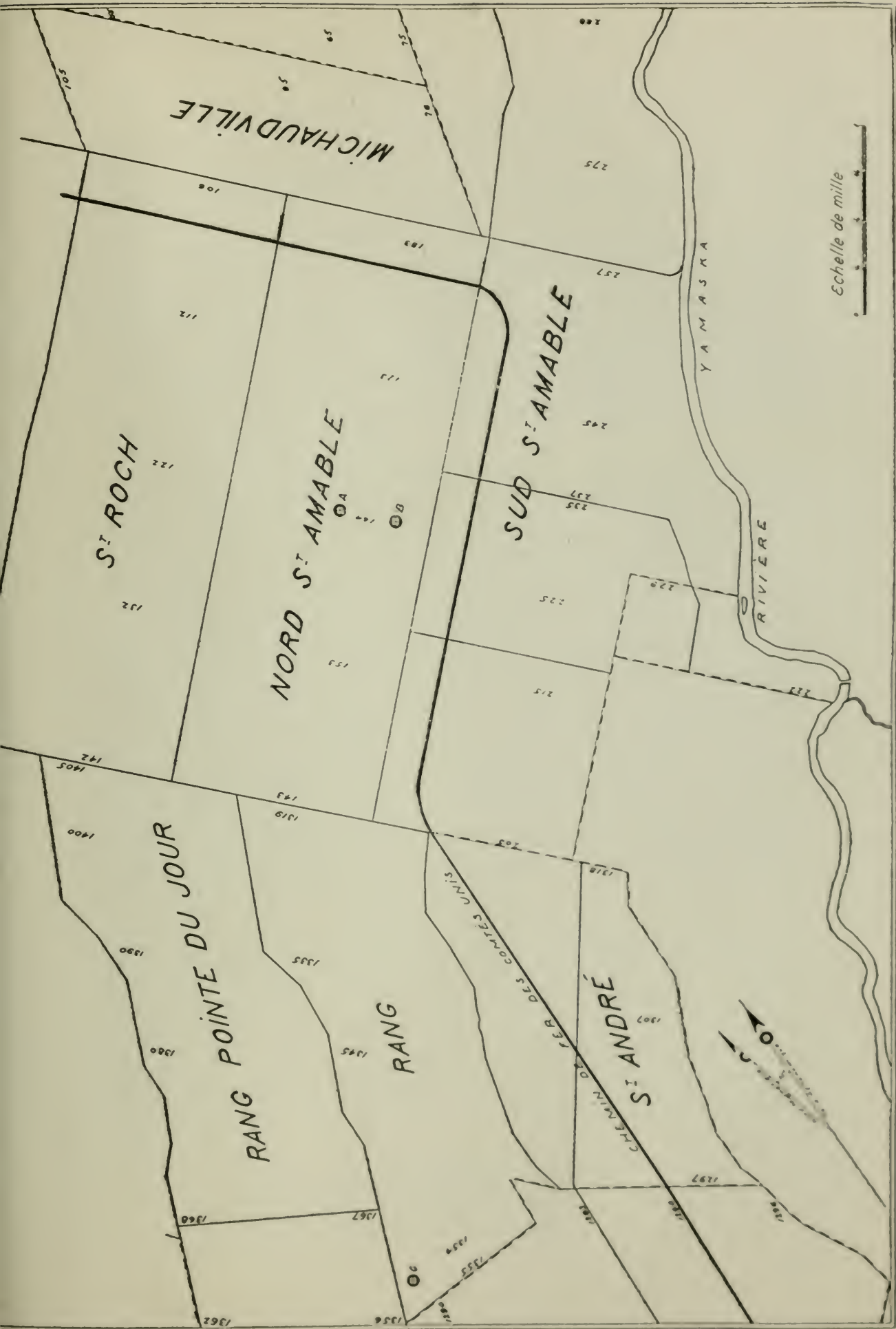
Well No. 4.—On lot 202, Grande Côte, Parish of Verchères, county of Verchères, to a depth of 2,300 feet. Drilled in 1910. Struck a little gas. Reached Trenton limestone.

In 1910, a local syndicate was formed, “La Compagnie de Gaz et de Pétrole de St. Barnabé”, to further test the territory in the vicinity of St. Barnabé, in the county of St. Hyacinthe. On the indication of gas bubbling in an old well, possibly the one mentioned by Mr. Obalski in his report for 1887, a well was put down on the farm of Mr. Joseph Fontaine, range St. Amable north, Cadastral subdivision 164, some six miles in a straight line north-east of the town of St. Hyacinthe. The well was begun on April 1st, 1910, and stopped on July 14th at a depth of 1880 feet. The well record, as obtained from the driller, was as follows:—

- 0 to 100 feet.—Drift clay, sand and gravel.
- 100 to 115 feet.—“Soapy” shales.
- 115 to 135 feet.—White sandstone, carrying a little salt.
- 135 to 935 feet.—Red shales.
- 935 to 1108 feet.—Grey shales.
- 1108 to 1114 feet.—Grey granite? (Sandstone?)
- 1114 to 1265 feet.—Black shale.
- 1265 to 1280 feet.—Magnesian rock, carrying salt.
- 1280 to 1860 feet.—Black shale.
- 1860 to 1866 feet.—Secondary calcite and quartz in shale,
which carries or covers the gas.
- 1866 to 1880 feet.—Black shale.

In the Report of Mining Operations for 1910, Department of Colonization, Mines and Fisheries, a condensed log of the well was given, which had been obtained from enquiries made on the ground, but since then, the above record was secured, which, therefore, supersedes the one previously published.

In this well, a strong flow of gas was struck at 1860 feet, the well was continued 20 feet further and capped. The rock pres-



Sketch map showing location of wells (A. B. C.) near St. Barnabé, St. Hyacinthe county.

sure was measured by an officer of the Mines Branch on November 10th, and found to be 275 lbs. per square inch.

The great prevalence of red shales between 100 feet and 935 feet would seem to indicate the presence of Medina shales. Underlying the Medina are the Lorraine schists which often reach a thickness of 2,000 feet, and the Utica, usually more or less bituminous, which are about 300 feet thick. The Trenton, which in the vicinity of Montreal and at St. Dominique, two miles east of St. Hyacinthe, consists of heavy beds of limestone, does not seem to have been reached.

In 1913, the Canadian Natural Gas Co., with Mr. N. Turcot as President, capital \$2,000,000, acquired all the rights of the St. Barnabé syndicate, and in June, 1914, began putting down a second well on the same lot, 1,000 feet to the south-east of the first well. In January, 1915, this well had reached a depth of 2,700 feet, without having struck any gas. Though unable to secure a detailed log, it was definitely ascertained that at the depth of 1,070 feet, the drill passed from the red shales, probably Medina, into grey shales, which latter appear to have been continuous down to the depth reached. This contact probably corresponds to the one struck at 935 feet in the first well. As it is very probable that the rocks underlying the surface are in folds which have a general trend of South-West North-East, parallel to the Champlain-St. Lawrence fault, the two wells are apparently on the east limb of an anticline, the crest of which would lie to the North-West of the first well.

Another company, "The National Gas Company", has secured rights immediately adjoining the territory controlled by the Canadian Gas Company. Their rights comprise ranges St. André, Pointe du Jour, St. Roch and Michaudville. A well was started in November, 1914, on the north end of lot 1354 of range St. André, on the farm of Albéric Leblanc. On January 20th, 1915, the depth reached was 2050 feet. The driller's log down to 1500 feet is as follows:—

- 0 to 110 feet.—Surface deposits.
- 110 to 140 feet.—Bluish shale.
- 140 to 190 feet.—Grey shale.

190 to	290 feet.—Red shale.
290 to	320 feet.—Brown shale.
320 to	440 feet.—Red shale.
440 to	500 feet.—Grey rock.
500 to	960 feet.—Red shale.
960 to	1020 feet.—Black shale.
1020 to	1500 feet.—Grey shales.
1500 to	2050 feet.—No report.

Gas was struck at 1,520 feet. The boring was continued to 2,050 feet without any further discovery of gas. The well is cased as follows:—Drive pipe 10-inch, 110 feet; 8-inch, 523 feet; 6-inch, 1,280 feet.

The well of the National Gas Company, as shown on the sketch map, is four miles distant from the wells of the Canadian Natural Gas Company, in a direction S.-E. The log given above shows that the contact between the red shales, (presumably Medina) and the black shales was reached at 960 feet. This agrees remarkably well with the logs of the wells on lot 164 of St. Amable north, and it may be inferred that the anticlinal fold has a general direction parallel to a line joining A-C on the map, and that the crest of this fold lies to the north-west of this line.

Complete sets of borings were obtained by the Geological Survey from the two last wells put down, and they are now being examined and classified. Moreover, Dr. R. Harvie and Mr. E. D. Ingall, of the Geological Survey, both visited the field and will probably report at length on it.

Oil and Gas on Island of Montreal.—During the fall of 1914, a number of claims for oil and gas were staked out on the island of Montreal, at Notre-Dame de Grâce, in the vicinity of the Blue Bonnets race course. In the course of digging a well in the superficial deposits, a strong odour of oil is said to have been noticed, and iridescent films were observed floating on the surface of pools of water. This occurrence gave rise to the staking of several claims by local people.

It may be observed that the underlying rock in this district is the lower part of the Trenton limestone, and that the underlying

Chazy outcrops a short distance to the north of the C. P. R. branch line which connects Mile End and Montreal West. Therefore, even supposing that the Trenton limestone of this district had once been oil-bearing, the eroding down of these limestone beds to near the base of the formation, preceded by the removal of all the overlying rocks likely to form an impermeable cap for the oil, and also the disturbed and broken state of the rocks in the vicinity of the igneous intrusion of Mount Royal, constitute very unfavourable factors for the presence of oil in this district.

No work has yet been done on these claims, but deep wells for water have been put down at St. Laurent, at Côte des Neiges, Outremont, some to the depth of 600 feet, and in none of these has the presence of oil been reported. On the contrary, most of them yield potable water.

During the last session of the Legislative Assembly, which prorogued in March, 1915, the following amendment to the Mining Law was passed, concerning natural gas and oil claims in the Province of Quebec :—

Act to Amend Quebec Mining Act, 5 Geo. V, ch. 35.

Art. 2137a.—Lands containing combustible natural gas, mineral oil or naphtha, may be staked or placed under a license either ordinary or for a long term, upon the conditions hereinafter set forth :—

(a) No staking or license shall cover more than 1,280 acres ;

(b) In surveyed territory, the area staked out or covered by a license shall consist of whole lots or regular fractions of lots ; in unsurveyed territory, such area shall form a rectangle, but, in either case, the width of the claim shall not be less than one-half its length ;

(c) The holder of a miner's certificate who wishes to obtain an ordinary license, must :

1. Produce an accurate description and a regular survey plan of the ground applied for ;

2. Pay the sum of \$10.00, as a fee, and an annual rental of ten cents per acre.

(d) Such license is valid for one year only, and is renewable once only on the same conditions;

(e) At the expiration of the renewal or of the original license, on proof of the discovery of combustible gas or of naphtha in appreciable quantity, the holder must provide himself with a special or long term license, covering a period of ten years, at an annual rental of twenty-five cents per acre, payable in advance. This latter license is renewable by ten-year periods, as long as the mineral lasts, and upon payment of the same rental of twenty-five cents in advance. (5 Geo. V, ch. 35).

2137b.—The staking out for marking a claim, or the issue of an ordinary or long term license, shall be effected in accordance with the formalities prescribed by the foregoing article 2126, and with the same effect, except that the direction given the side lines is optional, and the inscriptions are repeated on each of the stakes, with a mention, moreover, of the length and direction of the lines, and that the staking is done with a view to prospecting for gas and petroleum. (5 Geo. V, ch. 35).

2137c.—No renewal of an ordinary license, or issue of a long term license, shall be granted, unless it be established, by affidavit at least, that work has been done to the value of \$1.00 per acre, for every acre under license.

If the holder of a long term license ceases to bore or mine in the area covered by the license for a year, or does not continue doing so in good faith, the license may be cancelled after a notice of three months, during which period the holder may resume work at the Minister's discretion. (5 Geo. V, ch. 35).

MAGNESITE.

Owing to the cutting off of the world's main source of supply of magnesite, viz: the Austro-Hungarian deposits, keen interest has developed regarding the magnesite deposits of Argenteuil county, near Calumet. Numerous enquiries regarding these deposits have been received by the Quebec Mines Branch, and it

may be mentioned that in the Report on Mining Operations in the Province of Quebec for 1908, a full description of these occurrences was given.

Although the existence of these magnesite deposits has been known since 1900, they are not worked as actively as might be expected. The annual production is comparatively small, and is mainly used in the manufacture of carbonic acid gas. A really large production cannot be expected unless this magnesite can compete in quality with the Austrian product as refractory material in the manufacture of bricks and linings for iron and copper converters, open hearth furnaces, rotary kilns for cement, etc. For this purpose, the magnesite has to be thoroughly calcined, or "dead burned", so as to contain less than 1 per cent of carbonic acid.

"Dead-burned magnesite is magnesite that contains less than 1 per cent CO_2 , or that has been so thoroughly calcined that there is no deterioration or reversion on exposure to the air, by the absorption of carbonic acid. It is this form of magnesite that is used in the making of the bottoms of open hearths and for the manufacture of magnesite brick. The *crystalline variety* of magnesite is used exclusively for this purpose, and Austria-Hungary may be said to furnish it all. It is a difficult matter to dead-burn the white or massive variety, due to the fact that it decrepitates or burns to powder before all of the gas is driven out. Austro-Hungarian magnesite, on account of its containing chemically combined iron, is much more readily calcined to the dead-burned stage. It is also on account of this iron content that it is far more suitable in the making of open-hearth bottoms and in the manufacture of brick, for the iron fusing causes the magnesite to set."⁽¹⁾

"The presence of lime in magnesite bricks, used at high temperatures, is said to cause them to disintegrate more readily, and in basic steel furnaces the lime is believed to cause the phosphorus to pass into the hearth instead of the slag, the hearth thereby becoming rotten. Silica, oxide of iron and alumina are sup-

(1) Preparation and uses of Magnesite. — L. C. Morganroth, — Bull. Am. Inst. M. E., Sept. 1914.

posed to be objectionable, because they have a tendency to lower the fusing point. On the other hand, analyses of the imported magnesite which constitutes by far the greater part of the product consumed in the United States and is assumed to represent a standard of desirable composition for practical purposes in the metallurgical industry generally, show 3 to 4 per cent of silica, 6 to 8 per cent of iron, and 4 per cent of lime. Apparently there is some divergence of opinion as to the most desirable composition of magnesites to be adopted for metallurgical refractory uses.”⁽¹⁾

A typical crude magnesite from the Hungarian deposits has the following composition:—Silica, 0.75; iron oxide and alumina, 3.50; lime, 1.2; carbonic acid, 50; magnesia, 45 per cent.

“The method of mining and preparing magnesite in Austria and Hungary is practically the same in all plants. Following is a description of the Veitsch operation, as this deposit is the oldest and one of the largest found in Austria-Hungary: The deposit is a huge lens found in an isolated hill surrounded on all sides by barren rocks. It is on the outskirts of the village of Veitsch, which is about 65 miles south-west from Vienna. The entire top of the hill is magnesite. From the top to the base of the magnesite is from 700 to 800 feet, the bottom of the magnesite being about half-way down the hill. The quarry is worked in a series of steps or levels about 50 ft. apart vertically.

“The material is blasted out of the solid in the ordinary manner of rock quarrying. The magnesite is broken to one-man pieces, or less, and any particles of dolomite and quartz carefully sorted out. In the best deposits, there is always a large amount of this gangue. Practically one-half of what appear to be levels of the quarries are spoil banks. The magnesite, loaded on tram cars, is lowered by gravity planes to the base of the hill, where the works are situated. Here it is burned in continuous kilns of the bottle variety. These kilns burn on the average 12 to 15 tons in 24 hours. As a rule, producer gas is used as fuel. Within the last few years several plants have in-

(1) H. S. Gale, U. S. Geol. Bull. No. 540.

stalled kilns of the rotary or cement type to burn the magnesite, powdered coal being used as fuel. The capacity of these rotary kilns is probably 50 to 60 tons in 24 hours. The magnesite can be burned as thoroughly in these kilns as in the bottle kilns, but they have one disadvantage, in that a larger percentage of fines is produced.

The magnesite, as burned in the bottle kilns, is drawn about every 6 hours. It is quenched with water and then passes through a crusher, which reduces it to the size of a walnut or less. It is then screened, being separated into three sizes. From the screens it goes to the picking tables, where the under-burned pieces of magnesite, together with any dolomite or quartz, which were too small to be removed at the quarries, are picked out. The largest sizes of magnesite are again crushed and these smaller pieces are re-picked. The magnesite finally is crushed to the size of corn, again picked over, and then put in sacks holding from 150 to 200 lbs." (1)

The magnesite of the Grenville township deposits is of the crystalline variety, and some of it has been cut and dressed as white marble. A great number of analyses have been made showing from 75 to 95 per cent of carbonate of magnesia. An analysis by Mr. F. Connor, of the Department of Mines of Ottawa, gave :—

Carbonate of magnesia	84.50%
Carbonate of lime	15.00%
Oxides of iron and aluminium.....	0.37%
Insoluble	0.35%

Another sample, collected by Mr. J. Obalski, Superintendent of Mines of the Province of Quebec, gave :—

Silicon .....	.25
Lime	6.40
Magnesia	43.48
Carb. acid	50.41

(1) Preparation and Uses of Magnesite,—by L. C. Morganroth.

On comparing the descriptions of the Hungarian deposits with that of the Grenville occurrence, it is noticed that in both cases the magnesite is crystalline ; that although the Canadian magnesite in the crude state sometimes contains 20 per cent of carbonate of lime, it must be remembered that no sorting is done, whereas in the Austrian quarries a very large proportion of the material mined is waste, which is rejected.

Two of the most important manufacturers of magnesite refractory products in the United States are the Harbison Walker Refractories Co. of Pittsburgh, Pennsylvania, and the American Refractory Company, of Chicago.

BUILDING STONE.

The building stone industry of the Province of Quebec is a very important contributor to our mineral production. In 1914, the production of limestone reached a value of \$1,745,855, apart from the very large quantities used in the manufacture of cement and lime. The granite production for the same period had a value of \$582,235.

The stone industry of the Province of Quebec was the object of a very complete monograph by Dr. W. A. Parks, published in 1914, by the Mines Branch of the Canadian Department of Mines, Ottawa. The volume, which comprises over 300 pages and numerous illustrations, gives detailed descriptions of the producing areas, of the individual quarries, and of the various stones ; results of series of physical tests, such as weight, pore space, absorption, crushing, transverse strength, shearing strength, corrosion, etc. ; chemical analyses, quarrying methods and statistics. The following paragraphs taken from the introductory chapter of the report, gives an idea of the distribution and possibilities of our building stone resources :—

“The Province of Quebec produces limestone of structural quality in large amount ; it is rich in deposits of granite of various kinds ; it is rapidly assuming a position of importance as a producer of marble, and it possesses the only important slate quarries in the Dominion. Sandstone is quarried in small amount

and possibilities exist for the production of many of the rarer decorative substances.

Limestone of excellent quality is obtained on Montreal island, on Ile Jésus, and at various points north of the St. Lawrence river; it is largely quarried at Hull and at points in the Eastern Townships, such as St. John's and St. Dominique.

Important granite quarries are located at Stanstead, in the little Megantic mountains, and at other points in the Eastern Townships. North of the St. Lawrence, producing quarries are found in Argenteuil and Ottawa counties, and to the northward of the city of Quebec at Rivière à Pierre and Roberval. Dark basic rocks commonly called "black granites" are quarried at Mount Johnson, and opportunities for the production of this class of stone are afforded by many other localities.

Decorative and structural marbles are quarried on an extensive scale at Phillipsburg, in Missisquoi county, and in the township of South Stukely. The crystalline limestones of the great Pre-Cambrian area north of the St. Lawrence present many possibilities for the production of marble. A company has recently worked at St. Thècle, in Champlain county, and extensive operations are being planned for quarrying the white stone at Portage du Fort, in Pontiac county.

The production of sandstone is small and is practically limited at the present time to the hard whitish stone at Beauharnois. The Sillery sandstone near Quebec is still used in small amount, and a small quarry is operating in beds of Carboniferous sandstone on the north side of the Restigouche river. The Devonian sandstones of Gaspé present great possibilities, but they are not now being exploited.

Extensive deposits of serpentine are found in the Eastern Townships, and in the county of Grenville, but they have never produced decorative stone on a commercial scale and are not being worked at the present time.

Slate is quarried in the township of Melbourne and at Long lake, in Temiscouata county. Many other slate belts are known,

the commercial possibilities of which have never been thoroughly investigated.

The rarer decorative substances, particularly garnet-bearing rock, varieties of porphyry, and the iridescent feldspars, are known to occur in the province, and may prove a source of future supply.”⁽¹⁾

VITRIFYING CLAYS.

While clays suitable for the manufacture of bricks, common or pressed, are of widespread occurrence in the Province of Quebec, both as superficial clays and as shales, such is not the case for clays which can be used in the manufacture of stoneware, sewer-pipe and paving brick. For these purposes the clays, after being moulded into the required shapes, must be able to burn to a vitrified impervious body without losing their shape.

There are several manufactures of stoneware, pottery and sewer-pipe in the Province, but they use clay imported from England or from the United States.

It is, therefore, very interesting to note that in the course of his investigation on the clay and shale deposits of the Province, Mr. J. Keele, of the Department of Mines, Ottawa, has recognized that some of our shales have vitrifying qualities, and the following extracts from his report⁽¹⁾ will certainly stimulate clay manufacturers to investigate the possibilities of certain deposits:

Sillery.

“About a quarter of a mile south of Sillery church there is a bed of red shale which weathers into a soft plastic clay at the outcrop and even the harder portion under the weathered outcrop becomes quite plastic when ground and tempered with water. This shale burns to a hard red body at low temperatures, vitrified at about cone 1, and is not fused at cone 5. It would pro-

(1) Report on the Building and Ornamental Stones of the Province of Quebec, — by Dr. W. A. Parks,—Publication No. 279, Department of Mines,—Mines Branch, Ottawa.

(1) “Preliminary Report on the Clay and Shale Deposits of the Province of Quebec”,—by J. Keele, Department of Mines, Ottawa, 1915.

bably be suitable for making sewer-pipe or paving brick, but the material is inaccessible at this locality, as the line of the National Transcontinental Railway is built across it."

St. Charles de Bellechasse.

"The unaltered red shales of the Sillery formation outcrop at two points on the south side of the Boyer river near St. Charles. It forms the red soil on the illustration farm of the Commission of Conservation, owned by Mr. John Chabot, and the adjoining farm to the east. The red soil is seen again about a half a mile farther on in the fields of Mr. M. Fournier. The shale is exposed in a low ridge at this point. It is quite soft and crumbles down very easily, and the red weathered clay at the base of the ridge is quite plastic.

A sample of the fresh red shale from this locality was collected for testing. This shale was easy to grind, the ground material requiring 19 per cent of water for tempering. It worked up into a rather gritty mass of low plasticity, but was easily moulded into shape. Its drying qualities are good, the shrinkage on drying being 4 per cent. It gave the following results on burning:

Cone	Fire	Absorption	Colour
	shrinkage %		
010	0.0	13.0	light red
06	1.3	10.6	light red
03	4.5	2.7	red
1	6.3	2.2	brown
3	6.3	2.2	brown
5	6.3	2.2	brown

This is a good vitrifying shale, it has an ample margin of safety in firing, and the shrinkages are within working limits. As its plasticity is not very good, the working qualities are consequently deficient. Some short lengths of 3-inch pipe were made from it in a handpress. These were burned in a commercial sewer-pipe kiln, and salt glazed at cone 3, with good results, the

glaze being uniform and bright. This material is well suited for dry-pressing, and makes an excellent face-brick by this process. It has a solid bright red colour, and dense, hard body, when burned to cone 03.

If this shale is mixed with about 15 per cent of the very plastic surface clay which occurs in the vicinity, its working qualities are much improved, and it can be moulded for sewer-pipe, or for paving brick. It could also be used for rough-faced building brick by the wire-cut process. It can be burned to a very dense, steel hard body of rich, dark red colour at cone 03, or flashed to a steel blue at this temperature."

St. Apollinaire.

"A short distance east of St. Apollinaire station on the Intercolonial railway, the red colour of the soil seems to indicate that the soft, red Sillery shale underlies this locality. No samples were collected at this point, but it would probably repay investigation, as the material is well situated with regard to transportation. These unaltered beds in the Sillery are apparently the best structural materials so far discovered in the province."

LÉVIS FORMATION

Lévis.

In the vicinity of Lévis, the rocks comprising the Lévis formation cover a small extent of territory, being confined to a few square miles in the northern part of the town. They are mostly slates, sandstones, conglomerates, and slightly altered shales. The latter outcrop along the Intercolonial Railway for about 500 feet or more to the west of Ruel siding, near St. Joseph. These are rather gritty, thin-bedded, grey and rusty shales, dipping southeast at an angle of about 30 degrees. The soil in the fields and gardens on each side of the railway line is composed of the weathered portion of these shales, which in some places are quite plastic. The shales appear to be more altered and harder at some places than at others, and the harder kinds break down into splintery fragments which do not readily weather into clay.

A sample of these shales was collected from two points, one from near Ruel siding, and another from the roadside north of St. Joseph. Both samples gave practically the same results when tested. Although not a true shale, this material grinds fairly easily, and when tempered with 17 per cent of water has some plasticity, being quite as plastic as the Utica-Lorraine shale at Laprairie, which is used for brickmaking.

The Lévis shale has good drying qualities, and a shrinkage on drying of 4 per cent. It gave the following results on burning:

Cone	Fire	Absorption	Colour
	shrinkage %		
010	1.3	10.6	light red
06	1.3	9.0	light red
03	4.0	4.5	red
1	4.3	3.4	dark red
3	4.3	2.9	dark red
5	5.0	0.0	brown
9	Not softened		

This is a vitrifying shale and could probably be used for paving brick. It is rather gritty and lacks sufficient plasticity for moulding in a sewer-press, otherwise it could be used for this purpose, as the material takes a good salt glaze. With the addition of a little plastic surface clay, its working qualities could be improved so much that it could be used for the manufacture of vitrified wares, such as those mentioned.

It makes a fine dry-pressed face brick, with a good red colour, but not so bright as the Sillery shale from St. Charles, which it resembles.

The Lévis shale is the most refractory material so far found among the structural materials available in the province."

Sherbrooke.

"A few relatively small areas of Pre-Cambrian rocks occur in the hilly region south of the St. Lawrence. Included in these

rocks are some beds of talcose schist, which are quarried for building stone in the vicinity of the city of Sherbrooke.

This material when ground to pass a 20-mesh sieve and tempered with water, is not plastic. The ground schist, however, when slightly moistened, makes a dry press brick which can easily be handled in the green state, and could probably be set in kilns without crumbling. It burns to a pleasing greyish buff colour at cone 3. The body is hard and the surfaces have a slightly vitreous appearance, the absorption is 6.8 per cent. The schist is not refractory as it fuses at cone 2 (1370°C), but it is the most refractory brick material found so far in Quebec.

This rock has a silver grey colour when fresh, but other beds of similar schists contain a higher percentage of iron and are dark grey or rusty coloured. These can also be ground easily and made up into dry-pressed face brick. They burn to a deeper buff colour than the light grey schist, and would give a better effect in face bricks."

KAOLIN.

The report received from the Canadian China Clay Company, who operate the kaolin deposit at St. Rémi d'Amherst, on lot 5, range VI South, Amherst township, indicates that a great deal of development work was done during 1914 and some kaolin shipped, mainly to paper manufacturers. The question of railway transportation has so far militated against very active operations, as the nearest station is Huberdeau, on the Canadian Northern, seven miles distant, and the clay has to be hauled that distance over indifferent roads. It is expected that this will be remedied this year by the extension of the railway from Huberdeau to St. Rémi, the line of which will skirt the kaolin quarry.

This kaolin deposit is interesting as being the only workable one known in Canada. In his report on the clay deposits of the Province of Quebec, Mr. J. Keele⁽¹⁾ of the Geological Survey, describes this occurrence as follows:—

(1) Preliminary report on the Clay and Shale Deposits of the Province of Quebec, by J. Keele, Department of Mines, Canada, Ottawa, 1915.

"A deposit of kaolin, or white residual clay, occurs near St. Rémi d'Amherst, Labelle county, about 7 miles from Huberdeau, the terminus of the Montfort branch of the Canadian Northern Railway. The kaolin is found in dykes or veins of varying width in a ridge of quartzite lying on the east side of the wagon road 2 miles south of the village of St. Rémi. The slopes of the ridge are covered with glacial drift varying in thickness from 2 to 15 feet, as seen in the various cuttings and pits which have been made to reach the kaolin.

Mining operations have been in progress on this deposit since 1910, and a very complete plant is installed for washing the kaolin.

The prospecting so far done has shown that there are several veins of kaolin in the ridge, but some of them are too narrow to work. The main deposit is a vertical vein between quartzite walls in which kaolin reaches a depth of at least 150 feet, as ascertained by boring. This vein has been revealed by stripping the drift, or by test pitting for a distance of about 500 feet, and was found to vary from 15 to 30 feet in width. Two smaller veins about 4 feet wide have been uncovered in the vicinity of the main vein. Kaolin was also found in the bottom of a well at a point about 1,000 feet south of this property.

The rock that contains the kaolin veins varies from a massive, brownish, coarse-grained quartzite to a fine-grained white variety. It has a gneissic structure for a distance of several feet from the walls of the veins, where it is penetrated by stringers and films of kaolin. This contact zone is very friable and easily shattered.

The main kaolin vein seems to follow the direction of one of the principal joint planes in the quartzite, N. 53° W., for about 100 feet, and then bends to almost due north and south. The vein was originally composed of feldspar and quartz irregularly distributed. The feldspar became decomposed, and the soluble products of decomposition were carried away.

The crude material, therefore, is a mixture of fine-grained white clay and angular fragments of quartz, mostly under one-fourth of an inch in size. A small quantity of tourmaline is also present. In some parts of the vein the material is almost free

from quartz, but for the most part, quartz forms over 50 per cent of the deposit.

The lumps of crude kaolin coming from the mine are broken up in a blunger, an iron tank filled with water, in which a vertical shaft, furnished with horizontal arms, revolves. The quartz settles to the bottom of the tank, while the clay is carried off through an overflow pipe and led into a series of troughs, where the finest particles of sand are deposited. After flowing slowly through the troughs, the clay-water finally falls into settling tanks. The clay gradually sinks to the bottom of the tanks, and the clear liquid is pumped out. By means of this washing process the deposits yield from 30 to 40 per cent of fine-grained clay. A chemical analysis made from the washed clay by G. E. F. Lundell, gave the following results:—

Silica	46.13
Alumina	39.45
Iron oxide	0.72
Lime	none
Magnesia	none
Potash	0.20
Soda	0.09
Loss on ignition	13.81
	<hr/>
	100.40

The analysis shows the material to be of high purity. The physical tests are as follows: The washed kaolin requires 45 per cent of water for tempering. It has a fair amount of plasticity, but like all kaolin, it works rather short and crumbly. The shrinkage on drying is 7 per cent.

Cone	Fire shrinkage	Absorption
	%	%
010	3.0	34.3
06	3.6	34.3
1	4.5	32.0
5	9.3	20.0
9	11.3	17.0
34	Softens	

This material has greater plasticity and higher shrinkages than most of the standard brands of washed kaolin or china-clay. The samples for testing were taken from near the surface, but at deeper levels it is possible that the kaolin will not be so plastic and not shrink so much on drying and burning.

The Canadian China Clay Company, which operates this mine, is disposing of the washed product in Montreal, where it is used as a paper filler. On account of its fineness of grain and pure white colour, it is very suitable for this purpose.

Washed kaolin is one of the ingredients used in all whitewear pottery bodies, such as tableware, china, porcelain, wall tile, sanitary pottery, electrical porcelain, etc. Potters generally call it china-clay. It is the most valuable of all the clays."

Prospecting for Kaolin.

"Considerable prospecting has been done for kaolin in the vicinity of St. Rémi, but so far no other workable deposit has been uncovered. Two test pits were sunk on the property of the Canadian China Clay Company, 600 feet east of the main vein, and near the top of the ridge of quartzite. Some lumps of discoloured kaolin were found in the glacial drift at a depth of 5 to 8 feet below the surface, but no vein was reached.

About a mile north of the village of St. Rémi, on lot 9, range IV, some shallow pits dug on the bank of Pike creek revealed the presence of residual clay. The material was quite plastic, but very gritty, owing to the amount of quartz grains it contained. It is striped in yellow, white and pink bands. It appears to have resulted from the weathering of a quartzose gneiss. On account of its discoloration and its remoteness from transportation, this deposit appears to have no commercial value.

The rocks associated with the quartzite which contains the kaolin veins, are rusty gneisses, sillimanite gneiss, and minor bands of crystalline limestone. These appear to belong to the Grenville series, and occupy only a comparatively small area in

this locality. They are completely surrounded by granite gneisses, probably Laurentian.

The whole country has been heavily glaciated, and much of the residual clays which may have existed in pre-glacial time have been removed by erosion. A sheet of glacial drift materials, principally boulder clay, covers the slopes of the hills and the valley bottoms. The kaolin was first discovered by a farmer when sinking a well. He went through 15 feet of boulder clay and found the white clay deposit beneath. There are probably other deposits in the region, as the Grenville rocks occur at intervals as far west as the Ottawa river and beyond. The general prevalence of the drift covering renders prospecting a tedious and difficult operation, and kaolin being a soft deposit, is never exposed at the surface, unless a stream has cut down to it through the overburden."

POTASH IN FELDSPAR.

Potassium in a soluble form is one of the three essential constituents of a complete artificial fertilizer, and so far the most important use of Potash Salts is in the agricultural industry. Plant life takes up from the soil a great number of elements, but, of these, potassium, phosphorus and nitrogen are absorbed in comparatively large proportions, and unless the supply is renewed the land becomes exhausted. An idea of the important role which potassium plays in the plant growth may be gathered from the fact that wood ashes contain from 10 to 25% of potash (K_2O) in the form of potassium carbonate, and formerly hardwood ashes constituted the main source of potash.

At present the world's main supply of potash salts comes from the German deposits, of which the most important known are in Prussia, at Stassfurt, Sollstedt and Leopoldshedt. Within the last few years an important field has also been developed in upper Alsace, in the Mulhouse region, and is now producing in large quantities.

From the above it will be seen that the world is practically dependent on Germany for its supply of potash salts; its production

in 1912 amounted to 12,000,000 tons valued at the mines at \$30,000,000.

One of the first results of the present hostilities was, therefore, a very great increase in the price of potash salts in Canada and the United States. Stocks on hand in a few weeks, and even a few days, passed from \$40 a ton for 50% potash material, to \$120 and even more. Such high prices practically prohibit the use of these salts in the manufacture of artificial fertilizers, and although they somewhat eased off in the latter part of December owing to limited shipments from Germany, still the imports of potash salts into the United States during the last six months of 1914 were so far below normal, that abnormal conditions are to be expected for some time to come.

For a long time the various countries of the world have endeavoured to discover sources of potash which would render them independent of Germany for their supply, but so far, it must be owned, without great success.

The term "potash" is indefinite. Originally it was applied to the crude potassium carbonate obtained from the treatment of wood-ashes. It often is used for caustic potash, which is potassium hydroxide. In industry and trade, "potash" is now generally accepted as meaning potassium oxide (K_2O), which is taken as standard of potassium (K) contents of the various potash salts of commerce. This is only as a basis to compare the value of the various potassium salts, for, as a matter of fact, most of these are in the form of chloride (KCl), sulphate (K_2SO_4), carbonate (K_2CO_3), and nitrate (KNO_3), and usually as mixtures of these. For instance, potassium chloride, also called potassium muriate, or sylvite (KCl), contains theoretically 52 p.c. potassium (K), and is referred to in trade as 63% potash salt, because the 52% potassium corresponds to 63% potassium oxide (K_2O).

Feldspar is the mineral which has been the object of most of the attempts and experiments for the extraction of potash on a commercial scale.

This extraction is quite feasible, but, so far, the cost of such manufacture appears to be prohibitive.

Feldspar is a silicate of aluminium with oxide of potassium in *orthoclase*, sodium in *albite* and calcium in *anorthite*. These three types of feldspars pass and grade into one another by replacements and mixtures of the three oxides. The only feldspar which is interesting as a source of potash is, therefore, the potash feldspar, the type of which is orthoclase, containing a maximum of 16.9% of K_2O .

In orthoclase feldspar, the potassium is not in an available or soluble form, and the first operation on the mineral is to convert the insoluble potassium contents into a soluble form. A number of processes have been patented, most of which rest on the principle of mixing an alkali chloride, such as sodium chloride or calcium chloride with the finely ground potash feldspar, and submitting the mixture to a high temperature, which partly fuses it and converts the potassium oxide into soluble potassium chloride; this is then leached out by water, and from this solution the potash salts are obtained by evaporation.

The following is an extract from an article by W. C. Phalen, in the "Mineral Resources of the United States," 1913, published by the Geological Survey:—

"The Spar Chemical Co., with headquarters at Baltimore, Md., has done some experimental work on the extraction of potash salts from the silicate rocks at a plant located at Curtis Bay on the outskirts of the city. It is understood that the products are made according to the Thompson method, an outline of which was published in this chapter for 1911; this outline is repeated below.

Thompson's process is described in patent No. 995105, dated June 13th, 1911. It consists first of grinding feldspar rock so that it will pass through a 100-mesh sieve. The powdered rock is then mixed with an acid alkali sulphate and an alkali chloride, preferably acid sodium sulphate and sodium chloride, respectively. The proportions of the materials used are:—Feldspar rock, 5 parts by weight; acid sodium sulphate, 5 parts by weight; sodium chloride, 1.8 parts by weight. This mixture is heated from one to two hours at a bright red heat and becomes thereby

partly fused. The mass is then allowed to cool, is ground again, and is leached with water, which removes a mixture of sulphates of potassium and sodium. These salts are then separated by crystallization. The reactions are believed to be as follows: (a) The sodium acid sulphate reacts with the sodium chloride to produce hydrochloric acid gas and normal sodium sulphate; (b) The hydrochloric acid gas at the high temperature employed reacts on the feldspar, producing potassium chloride; (c) The potassium chloride is in turn acted upon by more of the acid sodium sulphate, producing hydrochloric acid gas and potassium sulphate.

The yield of potash is ordinarily from 80 to 90 per cent of the potash in the rock. For the best results, the temperature must be controlled within rather narrow limits."

A very interesting paper on this subject, by Messrs. Cushman and Coggeshall, of the Institute of Industrial Research of Washington, was read in December, 1914, at the annual meeting of the American Institute of Chemical Engineers, Philadelphia. This paper, entitled "Feldspar as a possible source of American Potash", was reproduced in full in "The American Fertilizer" of December 12th, 1914. The process which they describe is simple, and in outline is as follows:—

"A mixture of ground feldspar, containing about 10 per cent of K_2O and burned limestone, is formed into rounded aggregates or "clumps" about $\frac{1}{4}$ inch in diameter, by the device already employed, using a solution of calcium chloride for this purpose. Calcium chloride is the by-product of the ammonia-soda alkali process and is the reactive agent in unlocking the potash from the silica. Mixtures of powdered rock and dry calcium chloride are almost impossible to make, due to the attraction of the chloride for moisture. Moreover, simple mixing of two materials in the form of fine powders does not give an intimate enough contact of the reacting particles to produce good yields in furnacing operations in which neither of the particles is melted, so as to "wet" the other. In this particular case it was found that a proportion of burned lime mixed with the powdered feldspar will

unite with CaCl_2 from a solution sprinkled on the powder to form an oxychloride compound which cements the whole powder into aggregates, giving such a very intimate union of the particles that when heated the reaction yields are high.

These aggregates or "clumps" pass directly into the rotary kiln heated either by oil or powdered coal flame. The clumps fall out of the kiln in the same form in which they entered it, but the potash has been converted from the insoluble form into the water-soluble muriate. These red-hot clumps fall into water in leaching vats, where the potassium chloride goes into solution. Several of these leaching vats are used so that the solution of the salt, the leaching, washing, etc., are continually performed. The strong solutions are pumped to the evaporators. The weaker wash liquors are used as leaching liquids for a new lot of processed clumps."

As to costs of manufacture by this process, the authors calculate that with feldspar, containing 10% K_2O , delivered in lumps at the manufacture for \$1.00 a ton; calcium chloride at \$7.33 a ton; quicklime at \$2.33; and coal at \$2.50 a ton, the cost of manufacturing material running 50% K_2O , or corresponding to "80 per cent muriate" imported from Europe would be \$31.32 per ton. The plant itself would cost \$70,000, and would treat 300 tons of feldspar a day, yielding 47.54 tons of product.

In conclusion, the authors "record the fact that they are already familiar with many strong arguments which can be used against the advisability of attempting to manufacture potash in the United States. It is frequently stated that the Stassfurt potashes could be sold in this country for one-third of the prices which prevailed before the war and still yield profits to the foreign mines. Whether this statement is accurate or not, we have no means of ascertaining, but even if it is nearly true, it clearly proves that the words used in the introduction to this paper were not too emphatic, in which it is pointed out that special interest rather than the cost of production has controlled prices."

In the Province of Quebec we possess large and important deposits of feldspar, in the shape of dykes of pegmatite cutting the

Laurentian rocks, of which there is such a vast expanse to the north of the St. Lawrence.

A large deposit of this nature occurs on the north shore of the gulf of the St. Lawrence, on a peninsula which juts out in the Bay of Quatechou-Manicouagan, in the Mingan Seigniory. This is opposite the island of Anticosti, and some 40 miles below Pointe-aux-Esquimaux. In 1910, Mr. J. B. Tyrrell investigated the possibilities of these deposits, and his report, extracts of which were published in the Canadian Mining Journal of Jan. 1st, 1911, is very favourable. According to him, there are several pegmatite dykes, varying in width from 100 to 200 feet, and which can be followed for a mile or more. Two of these dykes were examined. The pegmatite is chiefly composed of orthoclase feldspar and quartz. The feldspar is pink to light grey in colour, some crystals attaining 12 inches in diameter. The rock consists in places almost entirely of feldspar, and in others entirely of quartz. But, for the most part, the feldspar is intimately mixed with small prisms and bands of quartz, and this intimate mixture of quartz and feldspar, of which feldspar constitutes 80 per cent or more, makes up by far the greater part of the dykes. Vast quantities of feldspar of the "Standard grade" of commerce, containing 10 to 12% K_2O , could be obtained from these deposits.

In the Buckingham district, north of the Ottawa river, feldspar is obtained as a by-product of mica mining. There is no doubt that throughout that region, large deposits of feldspar exist, and should need arise, prospecting would bring them to light at short notice.

Concerning the paper by Messrs. Cushman and Coggeshall quoted above, the "American Fertilizer", in an editorial, states that "The paper is an important contribution to the discussion of the problem, not only for the definite data it contains as to the details of the process and the cost of the final product, but also for its clear presentation of the obstacles which discourage the investment of American capital in the enterprise. If some assurance could be given that the market price of potash would not fall below the 1914 figures of the syndicate, for say ten years, it is probable that a prompt beginning would be made in produc-

ing it in this country. A reasonable profit would seem to be assured to the investors.

The United States takes more than half of the potash exported from Germany, and it is not reasonable to suppose that the Germans will allow their best customer to slip away from them without a fight. It is this fact that causes American capitalists to hesitate. The same reason makes them slow to enter other industrial fields, which for the moment seem attractive, but which will later bring them into sharp competition with well-established German concerns."

THE SAND-LIME BRICK INDUSTRY IN THE PROVINCE OF QUEBEC

Mr. A. O. Dufresne.

INTRODUCTION.

Sand-lime bricks are nothing else but an artificial sandstone, but a sandstone which does not desaggregate. They consist in a mass of quartzeous sand grains bound by a calcium hydro-silicate cement. This cement is the result of a chemical combination between the hydrated lime and a very fine siliceous sand, in an atmosphere of water vapour under pressure. This reaction, discovered by a German chemist, Dr. W. Michaelis, about 1880, was the basis of this industry.

The first experiments necessary to commercialize the discovery were performed in Germany. They were carried on during eighteen years, and, in 1898, sand-lime bricks were produced on a commercial scale. In 1908, Germany had 285 plants, producing annually from 90 to 130 million bricks.

In the United States, the first manufacture was established in Michigan City, Indiana, in 1901. In 1912, seventy-one plants could be counted, producing 190 million bricks.

In Canada it seems that "The Silicate Brick Co.", of Ottawa, was the first company to attempt to manufacture sand-lime

bricks. This company, incorporated in 1902, was operating in 1903. The total production of sand-lime bricks for the Dominion, for the year 1913, from the statistical figures published by the Federal Department of Mines, was 92,586,676 bricks.⁽¹⁾

From information taken from the Report on the Mining and Metallurgical Industries of Canada, published in 1908, we find that, in 1904, there was a company doing business under the name of "The Montreal Silicate Brick Co., Ltd.", that produced the material under consideration. In the same year, Joseph Decarie & Fils also put on the market bricks manufactured by a similar process. For reasons of which we are not aware, these two companies closed their plants after a few years. In 1912, two new companies again started the manufacture of sand-lime bricks,—one at Pointe-aux-Trembles, "The Brick & Tile Company of Canada",—and the other at St. Lambert, "The Canada Brick Co."

RAW MATERIALS.

In order to produce sand-lime bricks, two things are necessary—lime and siliceous sand. These materials having been well mixed, can be moulded into bricks of any dimension, form and colour, and even designs for architectural decoration can be obtained. After a few hours in an atmosphere of water-vapour under pressure, they can be immediately used.

SAND.

Any minerals which can pass screens all the way from 5 to 150 mesh, and are retained by the last, may generally be termed as sand. Those giving the best results in the industry under consideration are the quartz sands passing screens of 20 to 150 mesh.

In the manufacture, sand has two functions to perform: (a) a physical action; (b) a chemical action. The first one consists in forming the mass of the product; for this, coarse sand, which passes screens of 20 to 100 mesh, is used. The best results are

(1) Annual Report on the Mineral Production of Canada, during the calendar year 1913, Ottawa, 1914.

obtained with sand passing screens of 60 to 100 mesh. This is the part played by 90% of all the sand used. The chemical action—the combination of the sand and the lime to form the cement—necessitates only the tenth part of the sand. In order that this reaction be the most efficient, a very fine, sharp edged siliceous sand must be used.

The fineness of the sand is a factor which determines the perfection of the chemical reaction. Its presence is of the greatest importance, as it serves as index to appreciate the value of the product. The evidence of the part played by the fineness of the sand in the chemical reaction has been recognized and accepted, in theory at least, by the majority of manufacturers.

Practice has proved that the best proportion was one part of fine sand to nine or ten of coarse sand.

Effects of fineness and of shape of sand.—Fine sand fills in the interstitial spaces between the coarse grains and increases the efficiency of the chemical action in presenting a larger surface for the reaction. Too large a proportion of sand with sharp edges increases the absorption and the tensile strength and diminishes the crushing strength.

The round grains give superior results. But, the moulding of the bricks is much more difficult; the edges of the bricks are not sharp, the corners are broken and the faces rough. Their appearance is far from being as pleasing as the bricks made out of sharp sand. The latter presents smooth faces and nicely moulded edges and corners.

Impurities of sand.—In the sand-lime brick industry it is important to use only sand consisting of quartz grains, so that no foreign matter which might injure the product could enter the reaction.

Effects of clay.—The presence of clay in the sand reduces considerably the crushing and tensile strength. In conclusion of a series of tests, S. V. Peppel, Assistant State Geologist, Ohio, says:—"Clay up to 10 or 12% is probably not injurious, and possibly as small an amount as 2.5% might be desirable" to increase

the facility of moulding, as clay being an onctuous substance, acts as a lubricant and decreases the friction in the moulds. Moreover, clay diminishes the absorption.

Effect of feldspar.—The presence of feldspar in the sand decreases a little the crushing strength and increases the tensile strength. The feldspathic sands are not desirable, as under the influence of water-vapour under pressure they are decomposed.

LIME.

The purity of lime is essential in obtaining the very best results. That containing 98 to 99% CaO is recommended. The quantity of lime necessary to the reaction is equal, in weight, to from 5 to 10% of the sand. Magnesia, which is often associated to lime, being less basic than the oxide of calcium, hydrates much more slowly, and forms, with the sand, a much weaker cement, the tensile strength being only about a third.

To get a practical result in the utilization of the lime, the percentage of cement in the brick must not be in excess of what is required to produce a complete union of the grains, so as to form a compact and well bound mass. In other words, the quantity of lime should be just what would be sufficient to fill in the voids and to surround each grain with a film in a well combined mixture of fine and coarse sand.

The lime is hydrated before, while or after being mixed with the sand, according to the process which is followed. The sand and lime having been well mixed, taking into account the above considerations, and the hydration of the lime having been accomplished, the mixture, which must be more or less plastic, is now moulded in presses under a pressure equal to about 15,000 lbs. per square inch.

PRESSING AND HARDENING.

The presses are of the upright type or of the rotative table type. In Europe, the first type seems to be in favour, while in the United States both types are equally used.

The bricks having been moulded and pressed, must be hardened. They are, therefore, placed on little trucks which are wheeled into long steel cylinders; these are just as perfectly constructed as locomotive boilers. They are tested to withstand a pressure of from 180 to 200 lbs. per square inch. The bricks are left in these cylinders for 12 hours under a pressure of 100 lbs., or 8 hours under 120 lbs., or 6 hours under 150 lbs., after which they are ready for immediate use.

PROCESSES OF MANUFACTURE OF SAND-LIME BRICKS.

The manufacture of sand-lime bricks can be divided into three parts :—

(a) Preparing and mixing the raw materials, drying and screening of the sand, and hydration of the lime.

(b) Moulding of the mixture in the presses.

(c) Hardening of the bricks in the cylinders in water-vapour under pressure.

The different processes of manufacture differ from one another only in the method followed in the first stage. The two others are identical in all their methods.

The different methods of manufacture can be grouped in three classes :—

1. Wet slaking method.
2. Dry slaking method.
3. Caustic lime method.

In the first method, the lime, previously crushed to the size of an egg, is hydrated in a special apparatus by adding enough water to form a thick putty, which is siloed for twenty-four hours after being mixed with the sand. When the lime is completely hydrated, its volume increases $3\frac{1}{2}$ fold. By this increase of bulk, and by its plasticity, the lime coats every grain of sand with a film much more thoroughly than by the second method. On the other hand, this process is much more costly and does not allow screening. Consequently, lumps of unburned or overburned lime may find their way into the bricks.

In the second method, just enough water is added to produce a dry hydrated lime, which can be screened. The mixing is easily done, but it is doubtful if the grains of sand are as efficiently

covered by the film of lime as in the first method. In this process it sometimes happens that very fine grains of caustic lime pass through the screen, and, as happens in the first method, injure the brick during the hardening. The mixing of the hydrated lime with wet sand is much easier when the lime has been prepared by the first method.

The third method mixes the caustic lime with all or a part of the sand; in both cases the whole is crushed, and in the latter case the rest of the sand is added with sufficient water for hydration. Only the very best of lime can be used in this method. It is essential that it should be free from magnesia. Different processes, varying only in some little details, are grouped under this method; among these is found the "Division" process, which is used by the Canada Brick Co. and is described further on.

RESULTS OF TESTS OF SAND-LIME BRICKS.

The results of severe tests, made by qualified engineers on behalf of governments and scientific societies, prove that the sand-lime bricks, made with care, will resist the action of weather, fire, time, acid and humidity with more uniformity than the best qualities of clay-bricks. The sand-lime bricks have a very low thermal conductivity, a high electric resistance, and keep their initial colour. They have repeatedly passed, with success, the tests approved for building bricks, by the American Society for Testing Materials. Edifices built of this material are free from those white efflorescences which disfigure them so much.

TESTS.

The results of tests, on twelve samples, made and tested by S. V. Peppel, for the Geological Survey of Ohio⁽¹⁾ are as follows:

Weight per cubic foot	136 lbs.
Absorption	8%
Crushing strength	7,745 "
Coefficient elasticity	600,000

(1) Geol. Survey of Ohio, Fourth Series, Bulletins 4 and 5, 1906, p. 59

RESULTS OF TESTS FOR THE AMERICAN SOCIETY FOR TESTING MATERIALS.

By M. Curfman.⁽¹⁾

Reference Number	Number tested	Average ultimate crushing strength in lbs. per square inch.
1	12	4,344 lbs.
2	3	6,123 "
3	12	2,412 "
4	13	2,244 "
5	..	7,300 "
6	15	952 "
7	10	2,943 "
8	1	4,470 "
9	2	3,002 "
10	1	3,147 "
11	3	3,848 "

The crushing strength increases as the brick gets older. The sand-lime bricks, when successively frozen and thawed, have a greater crushing strength than bricks of the same age which have not undergone variation of temperature around 32°F.

TENSILE STRENGTH.

The tests of S. V. Peppel give an average of 425 lbs. to the square inch for tensile strength. The following is the result of two groups of experiments, each of which comprise 22 tests.⁽²⁾

Group A. 420 lbs. per sq. inch.

Group B. 720 lbs. per sq. inch.

The clay bricks give an average of 220 lbs. (Trautwine). W. S. Williams, of Ill. Geol. Surv., claims that,—

(a) The greatest tensile strength is obtained in mixture containing 20% of lime.

(1) Technograph, Vol. XIX, 1905, p. 72.

(2) Ill. State Geol. Surv. Bull. No. 18, p. 67.

(b) This tensile strength can be largely increased by adding asbestos.

ABSORPTION.

To dry a good brick mortar quickly and to make it stick, it is necessary that the brick should possess an absorption of 8%. Manufacturers should therefore seek to obtain a product, the absorbing power of which would be a little over the above figure. Too large a proportion of fine material in a brick increases the absorption. The proportion of fine material must be a minimum, or just what is needed to fill in the voids between the coarser grains.

TESTS ON SAND-LIME BRICKS

Made by the Pittsburgh Testing Laboratory (1)

Crushing strength per sq. in	Absorption tests 45 hrs. in water.	Crushing strength per sq. in. after freezing.	Absorption after freezing tests.
3,518 lbs.	11. 6%	4,137 lbs.	12.4%
4,162 lbs.	8.57%	5,202 lbs.	8.8%
3,859 lbs.	11. 3%	....	11.4%

TESTS BY S. V. PEPPEL, Ohio Geological Survey.

Composition of the Mixture.

No. of test	Sand	Parts	Lime %		Kaolin %	Absorp- tion %
1	Round grains..	95%	Pure CaO..	5%	....	8.95
2	Sharp sand....	95%	" " ..	5%	....	12.7
85	Coarse sand....	4				
	Fine "	1	Dolomite ..	5%	2½%	8.32
86	Coarse sand....	4				
	Fine "	1	" ..	5%	5%	8.0
87	Coarse sand....	4				
	Fine "	1	" ..	5%	10%	8.5

(1) Geol. Surv. of Ohio, Fourth Series, Bull. 4 and 5, p. 56.

No. of test	Sand,	Parts	Lime %		Kaolin %	Absorp- tion %
88	Coarse sand....	4				
	Fine "	1	Dolomite ..	5%	20%	9.0
83	Coarse sand....	3				
	Fine "	2	" ..	5%	....	8.06
93	Coarse sand....	4				
	Fine "	1	Pure CaO..	5%	21½%	8.62
94	Coarse sand....	4				
	Fine "	1	" "	5%	5%	8.6
A	Coarse sand....	2				
	Fine "	1	" "	10%	....	8.62
BBB	Coarse sand....	2				
	Fine "	1	Dolomite ..	10%	....	9.11
89						10.36
90						9.87
92						10.91
110						8.80
116						9.01
120						6.01
123						8.27
126						7.34

SWEDISH BRICK TESTS AT GOTHENBERG

(Ton-Ind. Zeit., Vol. 25, p. 1660)

1	13.1
2	13.6

GERMAN BRICKS (Vol. 25, Ton-Ind. Zeit., p. 575)

1	12.0
2	14.0
3	9.0
4	10.6

The ability of materials to resist weathering depends largely on their degree of absorption. If little water is absorbed (5 to 10%), it will be held up by capillarity, and will not segregate to form ice crystals in freezing, but if a large percentage of water be absorbed, ice crystals will be formed, which, by expansion, will work the grains apart from one another. It is possible to produce sand-lime bricks having an absorption of 5%, but they

are costly and undesirable, as an absorption of 8% is necessary to dry the mortar used in building. From the tests of S. V. Peppel, we learn that the majority of tests give an average of 8%, the weight of the dry brick being taken as a basis.

FIRE-TESTS.

The Underwriters' Laboratory of Chicago has obtained, with sand-lime bricks, very satisfactory fire-test results. It has been proved that after an ordinary fire, the crushing strength of these bricks was only slightly reduced. The tensile strength decreases as the inverse-ratio of the temperature.

FIRE-TESTS ON SAND-LIME BRICKS ⁽¹⁾

Temperature Degrees C.	Series A		Series B	
	Modulus of Rupture	Compressive strength, lbs. per sq. in.	Modulus of Rupture	Compressive strength, lbs. per sq. in.
000	430	4,382	717	3,430
300	238	4,980	418	3,900
400	145	4,650	388	3,710
500	95	3,720	197	3,340
600	83	4,440	142	3,320
700	68	4,155	100	2,640
800	68	3,130	116	2,400
900	33	2,050	85	1,700
1000	33	2,440	61	1,680
1100	26	2,350	37	1,280
1200	47	1,310	101	1,670
1300	131	2,250	210	2,505
1370	554	3,341	157	4,860

In Germany, a number of fire inspectors have made the statement that from their point of view, the sand-lime brick is a first class material of construction. In that country, as in Holland,

(1) Ill. State Geol. Surv., Bull. 18, p. 74.

these bricks have been used in the construction of municipal government buildings, the railroad companies also using, every year, a substantial quantity.

CONCLUSION.

Sand-lime bricks, when properly manufactured, have been accepted by the different European governments and scientific societies as a safe and reliable building material. The uniformity of their size, the smoothness of their surface, their absorption, their crushing and tensile strength, and their fire and weather resistance, have been established by results, the reliability of which cannot be questioned.

As a result of the different tests published in the transactions of scientific societies and in the bulletins of the technical bureaux of different governments, the architects and contractors have accepted this material for the construction of public buildings. In the city of Montreal, several are to be seen, namely: The Montreal Protestant High School, University street; Dandurand Building, corner of St. Denis and St. Catherine streets; The Grenadier Guards Armoury, Esplanade Avenue; Versailles Building, St. James street; Royal George Apartments, Bishop street; Ritz-Carlton Hotel, Sherbrooke street; The British-North American Bank, St. James street, etc.

SAND-LIME BRICK PLANTS IN THE PROVINCE OF QUEBEC.

From the Report on the Mines and Metallurgical Industries of Canada, 1907-08, we gathered the following information regarding the plants of Joseph Décarie & Fils, and the Montreal Silicate Co., Ltd., which ceased operations a few years ago.

Joseph Décarie & Fils, Montreal.

Works: St. Ambroise street, St. Henri, near Lachine Canal.

"The plant, which was not in operation during the latter part of the summer, includes:—One Leonard high speed engine, 45

h.p. ; one brick-cased boiler and one small upright boiler ; one P.H. and A. S. Morris brick press, built specially for sand and lime bricks, capacity 8,000 per day ; one Ross-Keller brick press, nominal capacity 20,000 ; hoppers, elevators, mixers, etc. ; 2 hardening cylinders, one 62 feet long, capacity 20 cars, each car holding 800 bricks, or a total of 16,000 ; one 25 feet long, capacity 5 cars, each car holding 1,000 bricks, or a total of 5,000 bricks, tested to stand 120 lbs. pressure.

"The sand is brought from Sorel in barges and delivered to the pug mill by bucket elevator. The lime is exposed in a screened cylinder to the action of exhaust steam, and then conveyed to the pug mill and mixed with the sand. The sand and lime pass from the pug mill into bins, and remain there 24 hours, being pressed into bricks.

The Montreal Silicate Brick Co., Ltd.

Not incorporated. Manager, J. A. Bell. Office and works : 500 Parthenais street, Montreal.

"This plant has been in active operation for the last three years, and has an annual output of about 2,500,000 silicate and cement silicate bricks. The equipment includes : one 65 h.p. B. & W. boiler ; one 65 h.-p. Leonard engine ; one American Clay Machine Co. press, capacity 20,000 bricks in 10 hours ; two steam cylinders, 36 feet long, 61½ feet diameter ; elevators, mixers, etc., etc.

"The lime is brought from Joliette, and the sand from Sorel, in barges."

The above firms ceased operations a few years ago. The two following firms are now in operation and producing (1914) :

Canada Brick Co., Ltd.

Sand from South Durham and lime from Missisquoi are brought by rail to the plant at St. Lambert, situated near the tracks of the G. T.R. The "Division" process is followed. It consists in dividing the sand into two parts, which are mixed with the lime at two different periods of the manufacture.

From the cars the sand is elevated to bins of a capacity of 750 tons. An 18-inch belt takes it to a rotary dryer in which only

50% is admitted ; the other half is hoisted by buckets to a bin in the upper part of the building. The dryer is a steel cylinder, measuring $22\frac{1}{2}$ ft. in length by $4\frac{1}{2}$ ft. in diameter, in the interior of which are steam-pipes connected to the central boiler. The sand is dried in order to facilitate the crushing in the tube mill. This dry sand is elevated to a second bin in the second story of the building.

The lime used comes from the burning of the Missisquoi marble ; it is shipped to St. Lambert as an oxide (CaO). As needed, it is crushed in a small Sturtevant crusher to the size of a hazel-nut, after which it is placed in a small bin in the upper part of the plant.

The dry sand and the caustic lime in a determined proportion of about 5 to 1 are now sent by spouts to the tube-mill. This is a steel cylinder measuring $22\frac{1}{2}$ ft. long by $4\frac{1}{2}$ ft. in diameter, making 25 revolutions a minute. The interior is lined with siliceous blocks, and is a little over half full of flint pebbles. In this tube-mill the sand is reduced to an impalpable pulp, which facilitates silicatization at an ulterior phase of the process. From the tube-mill the mixture goes through a double shaft differential mixer, where the second half of the sand (that which has not been dried or pulverized) is added to the mixture. The pug mill has two shafts, on which are set knives and blades adjusted to a convenient angle to give the product a propulsive motion towards the discharging end, one of the shafts revolving twice as fast as the other. The mixture next passes to a second pug mill, which differs from the first in that it has only one shaft. The lime is hydrated in the first mixer, where the necessary water is added. The mixture, which is now complete, is elevated into a silo, a large steel cylinder with a conic bottom and a vertical portion, dividing the interior into two equal parts. The dimensions are : 20 feet in diameter by 60 ft. in height. The mixture is left there from 10 to 12 hours, after which it is sent to the hoppers which feed the presses.

The plant has two presses : the vertical Berg press, of a capacity of 20,000 bricks, and a rotating table press of a capacity of 22,000 bricks per ten hours, made by the American Clay Machin-

ery Co. From the presses, the bricks are piled on small flat cars of a capacity of a thousand bricks each.

The last phase of the manufacture of sand-lime bricks, and the most important, takes place in two long steel cylinders measuring 65 feet in length by 6½ feet in diameter, which can hold 22 cars. The bricks are left in there from 10 to 12 hours in an atmosphere of water vapour under 140 lbs. pressure.

POWER:—A large 112 h.-p. boiler produces the necessary vapour to feed the cylinders of the last phase of the manufacture of the bricks, to dry the sand, and to heat the building during the winter months. The different pieces of machinery are set in motion by three induction motors respectively of 30, 40 and 100 h.-p., receiving a three-phase electric current under 550 volts.

The Brick & Tile Company of Canada, Inc.

Plant: Pointe-aux-Trembles. Office: 90 St. James street, Versailles Building, Montreal.

DESCRIPTION:—The sand comes from the neighbourhood of Joliette and the lime from the quarries of Joliette and St. Marc des Carrières. The process followed consists in pulverizing the caustic lime and mixing it with all the sand in two rotary drum mixers, where the necessary water for hydration is added. After a stay of twenty-four hours in a silo, the mixture passes through a dry pan grinder, next to the presses, and the bricks are finally hardened in an atmosphere of water vapour under pressure in the cylinders.

The caustic lime is delivered in lumps at the plant. When needed, it is crushed in a small jaw-crusher, pulverized in a ball mill, and, after screening, the impalpable pulp is delivered to a hopper. From the dump, the sand is hoisted to the upper part of the building on an incline, by cars of one cubic yard capacity. It is directly dumped into two rotary steel drums, with cone-shaped ends. Their exterior dimensions are approximately 10 ft. in length by 6 ft. in diameter. It is in these cylinders that the sand, which had no preliminary crushing or drying, is mixed with the lime in determined proportions. The drums are tightly

locked and the humidity of the sand starts the hydration of the caustic lime. The necessary water to be added to completely hydrate the lime is determined by the pressure developed in the interior of the drum, and which is recorded on the gauges. When the mixture is completed, the cylinders are emptied and their contents left for 24 hours in large silos placed underneath. From the hoppers, by rotary tables and a belt, the mixture is delivered to a bucket elevator which takes it to a dry pan grinder, containing blades and crushing rollers. The agglomerations of sand and lime having been crushed, the mixture passes to a rotating table press.

During the moulding of the bricks, the shocks and excess of pressure are absorbed by cylinders containing oil. A gauge indicates the pressure on the moulds. This press has a capacity of 24,000 bricks in 10 hours.

The rotary drum-mixer, the dry pan grinder and the press are of German make; they come from the Amandus Kahl's shops, Hamburg.

The bricks are next placed in one of the three hardening steel cylinders, measuring 56 ft. long by 6½ ft. in diameter, in an atmosphere of water vapour under a pressure of 130 lbs., from 10 to 11 hours.

POWER :—Two boilers of 250 h.p., made by John Englis & Co., working independently, furnish the necessary steam for the hardening of the bricks, for the motor which sets in motion the different parts of machinery. The water is filtered through an Ideal Feed Water Heater and Purifier, manufactured by Goldie & McCulloch.

BIBLIOGRAPHY.

Sand-Lime Brick, Geol. Surv. of Ohio, 4th Series, Bulletins 4 and 5, 1905.

Mining and Metallurgical Industries of Canada, Department of Mines, Ottawa, 1908.

Artificial Silicates with reference to Amorphous Silica, Ill. State Geol. Surv., Bull. 14, 1908.

Sand-Lime Brick, Ill. State Geol. Surv., Bull. 18, 1912.

Mineral Resources of the United States, U. S. G. S., 1912.

Mineral Production of Canada, Department of Mines, Ottawa, 1914.

Clay and Shale Deposits of the Province of Quebec, C. G. S., Memoir 64, 1915.

LIST OF THE PRINCIPAL OPERATORS AND OWNERS OF MINES AND QUARRIES IN THE PROVINCE OF QUEBEC.

ASBESTOS

- The Asbestos & Asbestic Co., Ltd.,**
James R. Pearson, Mgr., Asbestos, P. Q.
- The Asbestos Corporation of Canada Ltd.,**
R. P. Doucet, Secretary, 263 St. James Street, Montreal.
- The B. & A. Asbestos Co.,**
J. A. E. Audet, Manager, Robertsonville, P. Q.
- The Beaver Asbestos Co., Ltd.,**
c-o John Dugal, Secretary, Tecumseh, Ont.
- The Bell Asbestos Mines,**
Hon. Geo. R. Smith, Vice-Pres. and Mgr., Thetford Mines, P. Q.
- The Berlin Asbestos Co.,**
W. Rumpel, Mgr., Rumpelville, P. Q.
- The Black Lake Asbestos & Chrome Co., Ltd.,**
J. E. Murphy, Mgr., Black Lake, P. Q.
- The Eastern Townships Asbestos Co.,**
P. Anger Mgr., Beauceville, P. Q.
- The Frontenac Asbestos Mining Co.,**
F. W. Ross, Mgr., 92 St. Peter Street, Quebec.
- The Jacob Asbestos Mining Co., of Thetford,**
Paul Hammerick, Mgr., Thetford Mines, P. Q.
- Johnson's Co.,**
A. S. Johnson, Mgr., Thetford Mines, P. Q.
- Ling Asbestos Co., Ltd.,**
J. J. Penhale, Mgr., East Broughton, P. Q.
- The Martin-Bennett Asbestos Mines, Ltd.,**
H. E. Peters, Secretary, Thetford Mines, P. Q.

SILVER

- The Weedon Mining Company,**
L. D. Adams, Manager, Weedon, —P. Q.
- The Eustis Mining Co., Ltd.,**
F. M. Passow, Manager, Eustis, P. Q.

CHROME

The Black Lake Asbestos & Chrome Co.,
J. E. Murphy, Manager. Black Lake, P. Q.

Chrome & Asbestos Mines Ltd.,
c-o L. O. Ostigny, 2574 Du Parc Ave, Montreal.

Dominion Chrome Co.,
A. C. Calder, Mgr., 120 St. James Street, Montreal.

COPPER

Compagnie Minière Or et Cuivre,
Stratford, P. Q.

Eustis Mining Company,
F. M. Passow, Mgr., Eustis, P. Q.

A. O. Norton,
W. Jenkin, Manager, Coaticook, P. Q.

N. S. Parker,
Eastman, P. Q.

Pierre Tétreault,
407 Power Building, Montreal.

Weedon Mining Co., Ltd.,
L. D. Adams, Pres., Weedon, P. Q.

MINERAL WATER

Abenakis Mineral Spring Co., Ltd.,
W. E. Watt, Manager, Abenakis Springs, —P. Q.

Chris. E. Bédard & Dion Cie,
22 Bigaouette Avenue, Quebec, Qué.

Gurd & Co., Ltd.,
74 Bleury Street, Montreal, P. Q.

Lyall Trenholm & MacDonall,
Montreal West, P. Q.

Radnor Water Co.,
Geo. C. Kemp, Manager, Mark Fisher Building, Montreal, P. Q.

Cyprien Roy,
St. Germain, Co. Kamouraska, P. Q.

St. Léon Mineral Water Co.,
R. W. Nebbo, Mgr., St. Léon, Co., Maskinongé, P. Q.

M. Timmons & Son,
Quebec, Que.

IRON

The Canada Iron Foundries Ltd.,
Imperial Bank Bldg., Montreal.

International Tool Steel Co.,
W. C. Chapman, Mgr., 704-905 Traders Bk., Bldg., Totonto.

NATURAL GAS

The National Gas Co., of Canada.
c-o Mr. Arthur Ryan, Ottawa, Ont.

The Canadian Natural Gas Co.,
263 St. James Street, Montreal.

GRAPHITE

Bell Graphite Co.,
Box 185, Buckingham, P. Q.

Buckingham Graphite Co.,
Buckingham, P. Q.

The Canadian Graphite Co.,
T. W. P. Patterson, Mgr., Room 24, Coristine Building, Montreal.

The Dominion Graphite Co.,
H. P. H. Brumell, Manager, Buckingham, P. Q.

Graphite Ltd.,
220 Board of Trade Building, Montreal, P. Q.

Gatineau Graphite Mining Co.,
153 Davidson Street, Ottawa, Ont.

Quebec Graphite Co.,
A. A. Geister, Manager, Buckingham, P. Q.

MAGNESITE

Canadian Magnesite Co.,
J. E. Colby, President, 708 E. T. Bank Building, Montreal.

MICA

Thos. Argall,
Laurel, Co. Argenteuil, P. Q.

Blackburn Brothers,
H. S. Forbes, Manager, 134 Wellington Steret, Ottawa.

The Capital Mica Co., Ltd.,
W. Ahern, Manager, St. Pierre de Wakefield, P. Q.

- J. A. Chenevert,**
c-o Le Courrier, Sorel, P. Q.
- William Cleland,**
Bouchette, Co., Wright, P. Q.
- Cross & Wilson,**
Cascades, Hull, P. Q.
- H. T. Flynn,**
108 Montcalm Street, Hull, P. Q.
- J. B. Gauthier,**
Box 226, Buckingham, P. Q.
- J. B. Gorman**
Box 166, Buckingham, P. Q.
- F. A. Labelle,**
165 Main Street, Hull, P. Q.
- The Loughborough Mining Co.,**
N. J. Sproule, Mgr., c-o G. W. McNaughton, Sydenham, Ont.
- Rinaldo McConnell,**
175 Cooper Street, Ottawa, -Ont.
- R. J. McClashan,**
Wilson's Corners, Co., Wright, P. Q.
- O'Brien & Fowler,**
Bush Winning Mgr., 703 Hope Building, Ottawa.
- W. L. Parker,**
Buckingham, Co. Labelle, P. Q.
- Louis Richard,**
159-161 Arago Street, Quebec, P. Q.
- Ernest Shock,**
Schwartz, P. Q.
- Vavasour Mining Association,**
22 Metcalfe Street, Ottawa, Ont.
- Wallingford Mica & Mining Co.,**
41 Vaughan Street, Ottawa, Ont.
- Webster & Co.,**
274 Stewart Street, Ottawa, Ont.
- Edward Watts,**
19 Chestnut Park, Toronto, Ont.

TITANIFEROUS IRON ORE

- Baie St. Paul Titanic Iron Ore mining Expoet Co.,**
J. O. Paré, Manager, Baie St. Paul, Co., Charley oix, P. Q.

Gédéon Gagnon,
87 Artillery Street, Quebec.

Manitou Iron Mining Co.,
J. E. Globensky, Manager, 215 St. Catherine St. West., Montreal.

MOLYBDENITE

The Height of Land Mining Co.,
S. P. Wilson, Manager, 316 St. James Street, Montreal.

The St. Maurice Syndicate,
c-o A. E. Doucet, Quebec.

Chas. J. Higgerty,
Citizen Building, Ottawa, Ont.

GOLD

Champs d'Or de Rigaud-Vaudreuil,
Chambre 425, Transportation Building, Montreal.

Eustis Mining Co.,
F. M. Passow, Manager, Eustis, P. Q.

Weedon Mining Co.,
L. D. Adams, Manager, Weedon, —P. Q.

PHOSPHATE

Blackburn Bros.
H. L. Forbes, Manager, 134 Wellington St., Ottawa.

J. B. Gorman.
Buckingham, P. Q.

J. G. Higginson,
Buckingham, P. Q.

O'Brien & Fowler,
Bush Winning, Manager, 703 Hope Building, Ottawa.

Papineau Lumber Co., Ltd.,
H. T. Tétreau, Manager, Papineauville, Co. Labelle, P. Q.

Wallingford Mica & Mining Co.,
Perkins, P. Q.

Edward Watts,
19 Chestnut Park, Toronto.

OCHRE

Thos, H. Argall,
P. O. Box No. 2, Three Rivers, P. Q.

Canada Paint Co., Ltd.,
Jos. Bradley, Manager, Red Mill, P. Q.

Champlain Oxyde Co.,
P. D. Carignan, Manager, Thtee Rivers, P. Q.

François Ouellet,
Ste-Gertrude, Co. Nicolet, P. Q.

SAND

J. Aybram,
Ste. Emelie Jct., Co., Joliette, P. Q.

The Beaupré Sand Co.,
407 St. Valier Street, Quebec.

Alfred Bergeron,
Ste. Ursule, Co. Maskinongé, P. Q.

The Bonner Sand & Ballast Co.,
South Durham, P. Q.

Canada Lime & Builders Supply Co.,
126 Laurier East, Montreal.

Canadian Sand & Gravel Co.,
Richmond and Lachine Canal, Montreal.

Cement Products Co., of Canada.
105 Mountain Hill, Quebec.

D. Chevrier,
Sorel, P. Q.

Compagnie Sable Union Ltée,
105 Dalhousie St., Québec.

Cumming, Lawlor Sand & Supply Co.,
c-o H. F. Cumming, 258 Ottawa Street, Montreal.

Dominion Sand & Stone Co.,
703 Canadian Express Building, Montreal.

Francis Hankin, Co.,
201 Coristine Building, Montreal.

Imperial Sand & Gravel Co.,
Joliette, P. Q.

Joseph Labrecque,
Lanoraie, P. Q.

Laurentian Sand & Gravel Co.,
St. Gabriel de Brandon, Co. Berthier, P. Q.

Jules Miller,
300 St. Francis Street, Quebec.

Montreal Sand & Gravel Co.,
270 Ottawa Street, Montreal.

Quebec Central Ry,
Sherbrooke, P. Q.

Moise Robidoux,
Yamaska, P. Q.

Royal Moulding Sand & Gravel Co.,
Joliette, P. Q.

The Standard Sand & Gravel Co., Ltd.
P. O. Box 2652, Montreal.

St. Félix Sand & Gravel Co.,
Joliette, P. Q.

Napoléon St. Louis,
Fontarabie, P. Q.

The Touzin Sand Co.,
74 Common Street, Montreal.

Villeneuve & Co.,
St. Jerome, Co. Terrebonne, P. Q.

The Quebec, Montreal & Southern Ry, Co.,
Lanoraie, P. Q.

United Supply Co.,
173 Bleury Street, Montreal.

^x
National Silica Sands Ltd.,
11 St. Sacrement St., Montreal.

TALC

The Megantic Talc Co., Ltd.,
C. V. M. Temple, Manager, 175 Spadina Ave., Toronto, Ont.

Geo. R. Pibus,
Knowlton, P. Q.,

PEAT

Peat Industries Ltd.,
Imperial Bank Chambers, Montreal.

ZINC & LEAD

The Calumet Zinc & Lead Co.,
Geo. E. Murphy, Bryson, P. Q.

The Laurentide Mining Co.,
Notre-Dame des Anges, P. Q.

Pierre Tetrault,
Room 407, Power Bldg, Montreal.

Weedon Mining Company,
Weedon, P. Q.

SLATE

Fraser & Davis,
New Rockland, P. Q.

Glendyne Slate & Roofing Co., Ltd.,
New Rockland, P. Q.

New Rockland Slate Co.,
Room 408, Merchants Bank Building, 205 St. James St., Montreal.

BRICK

Ernest Beaudet,
St. Jean Deschaillons, P. Q.

J. & J. Beaudet,
St. Jean Deschaillons, P. Q.

Vve. Jos. Bernier,
821 Iberville St., Montreal.

Narcisse Blais,
12 Marie Incarnation St., Quebec.

Wilfrid Cantin,
51 Marie Incarnation St., Quebec.

Théo. Charland,
St. Jean Deschaillons, P. Q.

Citadel Brick & Paving Block Co., Ltd.,
P. Galarneau, Manager, 42 Dalhousie St., Quebec.

La Compagnie de Briques de l'Islet,
P. Kirouac, Manager, L'Islet, Pl Q.

La Compagnie de Briques les Becquets,
St. Pierre les Becquets, P. Q.

Pierre Desjardins & Co.,
Ste' Thérèse de Blainville, P. Q.

J. B. Desroberts,
St. Jean Seschaillons, P. Q.

Joseph Desrochers,
Warwick, P. Q.

Eastern Townships Brick & Mfg. Co.
Lennoxville, P. Q.

François Grenon,
1164 St. Valier Street, Quebec.

David F. Hodgins,
Box 87, Shawville, P. Q.

Lachute Brick Works,

Lachute, Co. Argenteuil, P. Q.

Lafontaine & Martel,

St-Tite, Co. Champlain, P. Q.

Alexandre Laliberté,

St. Jean Deschaillons, P. Q.

Laliberté & Potvin,

St. Jean Deschaillons, P. Q.

Evang. Laliberté,

St. Jean Deschaillons, P. Q.

Lucius Laliberté,

St. Jean Deschaillons, P. Q.

Stanislas Laliberté,

St. Jean Deschaillons, P. Q.

Edmond Lapointe,

Acton Vale, Co. Bagot P. Q.

Trefflé Leclerc,

Ste. Anne des Plaines, P. Q.

Emile Longpré,

St. Félix de Valois, P. Q.

Amédée Mathieu,

Victoriaville, P. Q.

Michel Mathieu,

Sorel, Co., Richelieu, P. Q.

National Brick Co. of Laprairie Ltd.,

10 Victoria Square, Montreal.

Ormstown Brick Co.,

Ormstown, Co. Chateauguay, P. Q.

Eug. Papillon,

St. Bazile, Co. Portneuf, P. Q.

Elie Paradis,

St. Raymond, Co. Portneuf, P. Q.

Paradis & Létourneau,

Stadacona, Quebec.

Ulric Paris,

St. Jean Deschaillons, P. Q.

Philippe Potvin,

St. Jean Deschaillons, P. Q.

Proulx Brothers,

Richmond, P.

F. Riquet,
Rimouski, P. Q.

The Sherbrooke Tile & Brick Co.,
Ascot Corner, P. Q.

The St. Lawrence Brick Co.,
La Presse Building, Montreal, P. Q.

Nazaire St. Onge,
Ste. Emelie, Clereville, P. Q.

Emile Théroux,
Mitchell, Sta., P. Q.

Joseph Tondreau,
St. Eugène, L'Islet, P. Q.

SAND, LIME, BRICK

Canada Brick Co., Ltd.,
Transportation Bldg, Montreal.

The Brick & Tile Co. of Canada,
J. A. Brodeur, Mgr., Pointe aux Trembles, near Montreal, P. Q.

LIMESTONE

James Baker,
Chateau, Richer, P. Q.

Pitre Beaudry,
Joliette, P. Q.

David Breault,
St. Jean, P. Q.

Napoléon Brunet,
St. Vincent de Paul, P. Q.

The Canada Iron Corporation Ltd.,
Mark Fisher Bldg., Montreal.

The Chateauvert Quarry Co.,
52 St. Paul Street, Quebec, Que.

The Church-Ross Road Co., Ltd.,
40 Hospital St., Montreal.

La Cie de Briques de Québec, Ltée.,
Beauport, Que.

La Cie des Carrières,
St. Marc des Carrières, P. Q.

Alfred Cossette,
Valleyfield, P. Q.

- Gaspard Defond,**
St. Cuthbert, Co. Berthier, P. Q.
- The L. Deguire Quarry Co.,**
St. Laurent, Near Montreal, P. Q.
- The DeLorimier Quarry Co.,**
1952 Iberville St., Montreal.
- The Deschambault Stone Co.,**
St. Marc des Carrieres, P. Q.
- Tite Desroches,**
Joliette, P. Q.
- Jos. Dubord,**
Valleyfield, P. Q.
- Martin Gagnon,**
2690 Chateaubriand Station, Montreal.
- Paul Gingras,**
Cap St. Martin, Co. Laval, P. Q.
- Joseph Gravel,**
488 Duluth Ave., East, Montreal.
- Aldéric Labelle,**
Village Belanger, Co. Laval, P. Q.
- Louis Labelle & Co.,**
St. François de Salle, P. Q.
- Elz. Laforce,**
St. Marc des Carrières, P. Q.
- Ovide Lapierre,**
830 Chemin de la Petite Côte, Montreal.
- Jos. Lapointe,**
St. Dominique, P. Q.
- Laurin & Leitch,**
5 Beaver Hall, Sq., Montreal.
- The Laval Quarry Co.,**
St. Frs de Sales, P. Q.
- Aurélien Laviolette,**
Cap St. Martin, P. Q.
- G. H. Leahy,**
128 Valois Street, Montreal.
- Hippolyte Lecrenier & Cie,**
Cap St. Martin, P. Q.
- Augustin Leroux,**
St. Vincent de Paul, P. Q.

Olivier Limoges,
477 Papineau St., Montreal.

Narcisse Lord,
St. Jean, P. Q.

O. Martineau & Fils, Ltd.,
371 Marie Anne Ave., Montreal.

Joseph Monette,
Village Bélanger P. Q.

Montreal Concrete Works Co., Ltd.,
225 St. James Street, Montreal.

Mount Royal Tunnel & Terminal Co., Ltd.,
c-o MacKenzie & Mann Ltd., Toronto.

Damase Naud,
St. Marc des Carrières, P. Q.

O'Connor Bros,
Huntingdon, P. Q.

Arthur Paquette,
St. Elzéar, P. Q.

Jules Petitjean,
2041 Papineau Ave., Montreal.

W. J. Poupore & Co.,
Room 200, McGill Bldg, Montreal.

Jos. Rhéaume,
2855 Boulevard Rosemont, Montreal.

Rogers & Quirk,
1701 Iberville Street, Montreal.

Shawinigan Quarry & Construction Co.,
c-o P. Bigué, Three Rivers, P. Q.

The St. Laurent Quarry Co., Ltd.,
Cap St. Martin, Co. Laval., P. Q.

Stinson-Reeb Builders Supply Co., Ltd.,
Eastern Township Bank Building, Montral.

Villeray Quarry Co.,
838 Du Rosaire Street, Montreal.

Wright & Co.,
267 O'Connor Street, Hull, P. Q.

General Contracting Co., Ltd.,
357 Kensington Ave., Montreal.

The Felix Labelle Quarry Co., Inc.,
Terrebonne, P. Q.

Institution des Sourds-Muets,
1941 St. Dominique Street, Montreal.

LIME

Arnaud & Beaudry,
Joliette, P. Q.

Bénoit & Fils,
St. Dominique, Co., Bagot, P. Q.

Arthur Boivin,
Pont Rouge, Portneuf, P. Q.

R, B, Carswell,
Bryson, P. Q.

Dominion Lime Co.,
Sherbrooke, P. Q.

C. A. Gervais,
1460 Cadieux St., Montreal.

Ephrem Lavallée,
St. Thomas, Co. Joliette, P. Q.

Olivier Limoges,
477 Papineau Ave., Montreal.

Z. O. Limoges,
40 Poupart St., Montreal.

Missisquoi-Lautz Corporation Ltd.,
Philipsburg, Co. Missisquoi, P. Q.

Thos. McCambly,
Kazubazua, P. Q.

Montreal Lime Co.,
31 Prenoveau St., Montreal.

Naud & Marquis,
St. Marc des Carrières, P. Q.

Placide Sanche,
Côte St. Louis, Ste. Thérèse, Co. Terrebonne, P. Q.

Sovereign Lime Works,
C. P. R., Track, De Lorimier Ave. Montreal.

Standard Lime Co., Ltd.,
St. Paul, Co. Joliette, P. Q.

Wright & Co.,
267 O'Connor & Hull Streets, Ottawa, Ont.

Jos. Lalumière,
St. Dominique, Co. Bagot, P. Q.

Hormidas Després,
Post-Office, La Chaloupe, Co. Joliette, P. Q.

SANDSTONE

H. T. Routhly,
Haileybury, Ont.

CEMENT

The Canada Cement Co.,
F. P. Jones, Manager, Herald Building, Montreal.

FELDSPAR

Canadian Feldspar Co.,
199 Bishop Street, Montreal.

S. Carsley, & Co.
151 Notre-Dame St. W., Montreal.

O'Brien & Fowler,
Bush Winning, Mgr., Rideau Street, Ottawa.

GRANITE

Argenteuil Granite Co.,
42-44 Craig St., W., Montreal.

James Brodie,
Graniteville, P. Q.

James Brodie & Son.
Iberville, Jct., P. Q.

La Compagnie de Granit de Mégantic Ltée.,
Lac Mégantic, P. Q.

Augustin Delisle,
Rivière à Pierre, P. Q.

Augustin Delisle,
Rivière à Pierre, P. Q.

Alex. Doyer,
Rivière à Pierre, P. Q.

W. M. Hazelton,
Beebe Jct., Co. Stanstead P. Q.

Dumas & Frère,
Rivière à Pierre, P. Q.

J. A. Lacombe,
St. Sébastien, Co. Frontenac, P. Q.

Laurentian Granite Co., Ltd.,
Room 94, 224 St. James St., Montreal.

S. B. Nortom,
Beebe Jct., Co. Stanstead, P. Q.

Jos. Perron,
Rivière à Pierre, —P. Q.

Stanstead Granite Quarries Co., Ltd.,
Beebe Jct. Co. Stanstead, P. Q.

G. S. Somerville,
Beebe Jct., Co. Stanstead, P. Q.

Fortunat Voyer,
Rivière à Pierre, P. Q.

Henri Provencher,
Bédard, Co. Labelle, P. Q.

Léo. Lafond,
2611 Hutchison St., Montreal.

Rigaud Granite Co., Ltd.,
137 McGill St., Montreal.

KAOLIN

Canadian China Clay Co., Ltd.,
P. O., Box. 292, Montreal.

MARBLE

The British Canadian Marble Co., Ltd.,
c-o R. Simpson, St. Joseph, Beauce, P. Q.

La Cie de Marbre du Canada.
c-o Victor Côté, 153 St. Hélène St., Quebec.

Dominion Marble Co., Ltd.,
P. O., Box 1166, Montreal.

Missisquoi-Lautz Corporation,
Philipsburg, P. Q.

Pontiac Marble & Line Co., Ltd.,
193 Sparks Street, Ottawa.

POTTERY

E. L. Farrar,
Iberville, P. Q.

J. N. Matte,
40 Dominion Building, St. Peter St., Quebec.

Montreal Fire-Brick Works Ltd.,
399 St. Ambroise St., Montreal.

Montreal Terra-Cotta Lumber Co.,
Lakeside, P. Q.

W. D. Bell,
1286 St. Valier Street, Quebec.

STATISTICS OF THE ACCIDENTS

REPORTED IN THE MINES AND QUARRIES OF THE PROVINCE OF QUEBEC, FOR THE CALENDAR YEAR 1914.

A. O. DUFRESNE, *Inspector of Mines.*

Together with the other industries of the Province of Quebec, the mining industry has recorded, during the calendar year 1914, a decrease in its production, which reflects on the number of men employed and on the amount of salaries paid.

From the 1st January to the 31st December, 1914, the average number of workmen (year-men) engaged in the mines, quarries, clay-pits, sand-pits, concentrating mills, shops, etc., in the Province of Quebec, was 6,956; in 1913, this figure reached 8,611; therefore representing a decrease of 1,655 for the past year, or 19.2%. The salaries paid to these workmen reached only \$4,365,439 in 1914, against \$5,401,702 in 1913, which is a drop of \$1,036,263, or 19.2%. The total number of days of work was 2,087,063, to which 9,168 men contributed. In the Annual Report for 1913, we see that 9,925 men worked during a total of 2,583,673 days.

For statistical purposes, we shall take as a basis 300 days of work per man per year, and this we will designate as a year-man.

$$2,087,063 \div 300 = 6,956.$$

TABLE No. I.

PERSONS EMPLOYED IN THE MINES, QUARRIES AND CONCENTRATING
MILLS IN THE PROVINCE OF QUEBEC, IN 1914.

	Number of Days Labour	Number of Men Calculated on 300 Days
Asbestos (quarries & Mills).....	752,847	2,509
Copper & Pyrite (mines and concentrators).....	76,950	257
Mica, Phosphate, Graphite.....	48,392	161
Ochre.....	11,650	39
Mineral Water (Springs & Works).....	3,033	10
Chrome, Titaniferous Ore, Zinc, Lead, etc.....	11,466	38
Pottery, Feldspar, Kaolin, Quartz (pits and mills).....	58,490	195
Cement (quarries and mills).....	269,330	898
Lime (quarries and kilns).....	71,423	238
Limestone (quarries and dressing works).....	368,961	1,229
Granite.....	122,438	408
Slate, Marble and Sandstone.....	31,210	104
Building Sand (pit and river).....	58,003	194
Brick (clay-pits and brickyards).....	202,870	676
	2,087,063	6,956

TABLE No. II.

	Number of Workmen	Salary	Number of days Labour	Number of men 300 days
In producing mines.....	8,971	\$4,291,735	2,055,946	6,853
*In non-producing mines.....	197	74,269	31,117	103
Totals.....	9,168	\$4,365,439	2,087,063	6,956

* This does not include assessment work required by the Mining law on claims in the early stage of prospecting and development.

During the calendar year 1914, the Bureau of Mines recorded 139 accidents, of which 9 were fatal. Table III gives the average number of men employed in the mines and quarries, and the number of accidents, fatal and non-fatal, corresponding to each group.

TABLE No. III.

	Average number of workmen	Accidents			
		Fatal	Non- Fatal	Total	per 000
Mines.....	3046	9	102	111	36
Quarries.....	3910	0	28	28	7
	6956	9	130	139	20

The Bureau of Mines of the Province of Quebec defines a non-fatal accident as one which physically incapacitates a man for ten days or more.

For each 1,000 year-men employed, the fatal accidents averaged 1.29. In 1913 we recorded 197 accidents, of which 16 were fatal, giving a proportion of 1.86. The examination of Table III shows that no fatal accidents have happened in the quarries of this Province during 1914. Accordingly the nine fatal accidents registered must be averaged over the 3,046 men who worked in the mines, whence we get 2.95 per 1,000 against 3.19 in 1913.

TABLE No. IV.

ACCIDENTS IN THE MINES, QUARRIES AND MILLS IN THE PROVINCE OF QUEBEC, 1914.

	FATAL		NON-FATAL		TOTALS	
	Number	%	Number	%	Number	%
Mines:						
Underground.....	4	2.9	3	2.1	7	5.0
Open Pits.....	4	2.9	66	47.5	70	50.4
Surface.....			14	10.1	14	10.1
	8	5.8	83	59.7	91	65.5
Quarries:						
In Pits.....			22	15.8	22	15.8
Surface.....			5	3.6	5	3.6
			27	19.4	27	19.4
Mills,						
Mills.....	1	0.7	12	8.6	13	9.3
Shops.....			6	4.3	6	4.3
Power Plants.....			2	1.5	2	1.5
	1	0.7	20	14.4	21	15.1
Totals.....	9	6.5%	130	93.5%	139	100%

TABLE No. V.

ANALYSES OF THE FATAL ACCIDENTS IN THE MINES, QUARRIES AND MILLS OF THE PROVINCE OF QUEBEC DURING 1914.

	Underground		Open Pits		Total	
	Number	%	Number	%	Number	%
Mines:						
Falls of ground.....	2	22	1	11	3	33
Explosives.....	2	22	1	11	3	33
Cable-derricks.....			2	22	2	22
	4	44	4	44	8	88
Quarries:						
Mills.....						
Shafting.....	1	12			1	12
Totals.....	5	56	4	44	9	100

A glance at the above table will show that the fatal accidents in the mines are due to three causes: falls of rock, handling of explosives, and the operation of the cable-derricks in the open pits. Table VI. shows that 68.8% of the non-fatal accidents in the mines are to be ascribed to the same three causes, and that 52% of the accidents in the quarries are to be clasified with, viz., falls of rock and explosives.

Only one fatal accident occurred in the mills. A shaft situated at a height of 40 inches above the fourth floor of a concentrating mill was responsible for the death of a mill hand. This unfortunate man's clothes were caught by the revolving shaft and the victim was whirled to the floor with broken arms, legs and skull. It may be remarked here that shaftings of mills, power plants, shops, etc., are a constant source of accidents, which almost invariably cause a mortality. The best preventive to this would be a closed guard or crating around all dangerously placed shafts.

TABLE No. VI.

ANALYSIS OF ACCIDENTS IN THE PROVINCE OF QUEBEC DURING THE YEAR 1914.

NON-FATAL.

Mines	Underground	Open Pits	Surface	Totals
Falls of ground.....		28	1	29 - 35.0%
Cable-derricks.....		18		18 - 21.7%
Explosives.....		10		10 - 12.1%
Cars and Tracks.....			10	10 - 12.0%
Falls of object.....	2	1	2	5 - 6.0%
Falls.....		4		4 - 4.8%
Breaking stone.....		4		4 - 4.8%
Ladder.....	1			1 - 1.2%
Drilling.....		1		1 - 1.2%
Electric shock.....			1	1 - 1.2%
	3 - 3.6%	66 - 79.5%	14 - 16.8%	83 - 100 %

TABLE No. VI—NON-FATAL—*Continued.*

Quarries	In Pits	Surface		Totals
Falls of ground.....	11	.....	.....	11 - 40.8%
Falls.....	3	.....	.....	3 - 11.1%
Explosives.....	3	.....	.....	3 - 11.1%
Cars and Tracks.....	.....	3	.....	3 - 11.1%
Miscellaneous.....	1	2	.....	3 - 11.1%
Steam.....	2	.....	.....	2 - 7.4%
Drilling.....	1	.....	.....	1 - 3.7%
Tramming.....	1	.....	.....	1 - 3.7%
	22 - 81.5%	5 - 18.5%	.....	27 - 100%

Mills	Mills	Shops	Power Plants	Totals
Machinery.....	4	2	2	8 - 40%
Falls of objects.....	1	4	.....	5 - 25%
Belt dressing.....	2	.....	.....	2 - 10%
Drilling.....	.....	2	.....	2 - 10%
Ladder.....	1	.....	.....	1 - 5%
Falls of ore.....	1	.....	.....	1 - 5%
Falls.....	1	.....	.....	1 - 5%
	10 - 50%	8 - 40%	2 - 10%	20 - 100%

Table VI. shows that 63.9% of the non-fatal accidents have occurred in the mines, 20.7% in the quarries, and 15.3% in the mills. An examination of the preceding table shows that the principal causes of the non-fatal accidents in the open-pits and quarries were falls of ground.

From the monthly classification of falls of ground, we learn that the month of April is the leader, this being the month in which the largest number of these accidents has been recorded. No doubt, the reason for this can be ascribed to the successive thawings of the ground during that period of the year, favoured in the asbestos mines by the slippery nature of the rock. A few companies, for reasons of safety, choose to suspend operations for a number of days at the time of the thawing of the ground.

TABLE No. VII.
FALLS OF GROUND BY MONTHS—1914.

Non-Fatal	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Underground.....													
Open Pits.....	1	1	2	7	2	1	3	4	2	1	4	1	29
Quarries.....	2	1			1	2		1	1	1		2	11
Fatal													
Underground.....		1										1	2
Open Pits.....								1					1
Quarries.....													
	3	3	2	7	3	3	3	6	3	2	4	4	43

In the asbestos mines, the hoisting of the ore by means of cable-derricks, as practiced at present, is not without danger. Table IV. shows that 21.7% of the non-fatal accidents in the mines result from this practice. From the reports received at the Bureau of Mines, we note that these accidents have had the following causes :—A man being too near the landing place of the box, is struck by it as it touches the bottom of the pit ; during the hoisting of the box, sometimes pieces of rock fall on the miners below ; the shovellers, when occupying dangerous positions, while loading, are often injured by rolling stones. Other cases may also be added ; an accident was caused by the breaking of one of the three chains suspending the box of the cable-derrick. A flaw in the welding of an anchorage ring was responsible for the death of one man and the injuring of two others. We cannot too strongly oppose the prohibited practice of hoisting men to the surface in the boxes of the cable-derricks. The practice of lifting the large pieces of rock with chains is very dangerous, and in looking over the detailed table of accidents, one is astonished at the number of men who have been injured as a result of this practice.

The use of explosives in the mining operations is also responsible for its quota of accidents. Table VI. attributes to it 33% of the fatal accidents ; Table VII. 12% of the non-fatal in the mines and 11% in the quarries. It is very much to be regretted that some of these accidents are the result of practices absolutely in opposition to the most elementary rules in the handling of explosives, as, for example, using frozen dynamite and tamping with a steel rod.

Around the mines, as well as around the quarries, the haulage by railways is responsible for the larger number of accidents occurring on the surface. It would appear as if the brakesmen were especially reckless in coupling cars.

In the concentrating mills, the principal cause of accidents may be attributed to a lack of care on the part of the workmen operating machinery. Under this item is classified 40% of the accidents occurring in the mills.

In the shops, the falls of objects from the tables or from the hands of the employees are responsible for the majority of the accidents ; the others may be attributed to the machinery and the drilling of metallic pieces.

TABLE No. VIII.

AGE OF THE MEN INJURED—1914.

	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	Un- known	
Non-Fatal....	20	18	23	22	10	13	3	5	9	3	4	130
Fatal.....	.....	1	3	1	2	1	.....	.....	1	.....	.....	9
	20	19	26	23	12	14	3	5	10	3	4	139

Table VIII, which classifies the accidents by the age of the victims, is not without interest, though, to be complete, it should have opposed to it the total number of men of each class employed in the mining industry. It is interesting to note that the class 56-60 accounts for ten accidents, while the neighbouring classes register respectively five and three victims. It is not probable that the number of men of this class is greater than that of the adjoining classes. From the detailed table of accidents, we learn that the accidents in this class are due to the following causes: falls of ground, falls of objects, falls of person. This would seem to infer a decrease in certain physical faculties of the victims, such as, a weakening of hearing and of sight, and, perhaps, above all, a loss of agility.

BLASTING AT THE JEFFREY MINES.

Until last summer, the firing of block-hole blasts at this mine was exclusively done by ordinary fuses. About fifty miners were employed to prepare and "spit" the fuses twice a day. When through with the "spitting" of the fuses, the men were hoisted up to the surface in the boxes of the cable-derricks. This practice, which was excessively dangerous, has been done away with. To-day, the blasting is done by an electric current of 110 volts. A squad of five or six experienced men is continually loading and testing the circuit with a galvanometer. For safety, on the special electrical current, four switches have been placed, one in the signalling stand and the three others in the compressor building, i.e., two near the entrance door, used to light the building, and the other in a glazed box with a padlock. The only person in possession of a key for this box is the foreman of the blasting squad.

All the men in the mine have to walk up the stairs. It is admitted that a real economic advantage has resulted from the introduction of this method, as well as a greater degree of safety afforded the men in the mines. The almost complete elimination of missed-fires has increased the efficiency of the blasting.

PRECAUTIONS TO BE TAKEN IN THE STORAGE AND HANDLING OF EXPLOSIVES.

For the benefit of miners, we publish here below a list of the main rules enforced in the well managed mines of America concerning the handling of explosives.

Don't store detonators with explosives.

Don't open packages of explosives in a magazine.

Don't open packages of explosives with a nail-puller, pick or chisel. Use a hardwood wedge and mallet.

Don't store explosives in a hot or damp place.

Don't use explosives which are frozen or partly frozen.

Don't thaw explosives before an open fire, nor in a stove, nor over a lamp, nor near a boiler, nor near steam-pipes, nor by placing cartridges in hot water.

Don't thaw explosives by placing the cartridges in your pocket or by body heat.

Don't carry detonators and explosives in the same package or in the same hand.

Don't handle explosives or detonators near an open flame.

Don't expose explosives or detonators to direct sunlight for any length of time.

Don't open a package of explosives until ready to use the explosive; then use it quickly.

Don't handle explosives carelessly.

Don't crimp a detonator (blasting cap) around a fuse with the teeth; use a cap crimper.

Don't economize by using a short length of fuse.

Don't make a hole in a cartridge with an iron or steel tool; use a wooden needle.

Don't use a metal tamping rod.

Don't return to the face for at least one hour after a mis-fire.

Don't burn boxes having contained explosives in stoves or furnaces.

Don't smoke when in a place containing explosives or while handling them.

THE UNIVERSAL DANGER
SIGN



DANGER

Don't use a fuse to blast in shafts, winzes, and, in general, in places difficult to evacuate; use electricity.

Don't clean or withdraw a mis-hole. Take off only a little of the tamping and blast the hole with a small charge. It is the safest way to prevent an accident.

After blasting, the men who have prepared the charges should examine every hole, mark, by a conventional sign, the mis-holes, and report same to the shift-boss, who will register the report.

A UNIVERSAL SYMBOL OF DANGER.

A number of companies have made a practice of erecting sign-boards as a warning for their employees of the proximity of causes of danger. This movement is a loyal effort which ought to be encouraged. But, as a large proportion of the workmen in the mines are recruited from the ranks of those who can read neither English nor French, we think that a sign universally recognized as the symbol of danger should be adopted. The Bureau of Mines of the United States has drawn attention to this question and has happily suggested "that a circle filled with red, making a red ball, and painted on a white background, be adopted as the universal symbol of danger."

MINES, QUARRIES AND MILLS—PROVINCE OF QUEBEC.

FATAL ACCIDENTS 1914.

No.	Date	Mine or Quarry	Name of Operator.	Name of Injured.	Age.	Occupation.	Nature of Injury.	Cause of Accidents.
1	Jan. 26	Jacobs' Mine.....	Jacobs Asbestos Mining Co. Ltd.....	John Berard.....	21	Sweeper.....	Both arms and hands torn off, skull badly fractured and gaping wound in head.	Clothes caught by 3" shaft, 40" above ground on 4th floor of mill.
2	Feb. 27	Eustis Mine.....	Eustis Mining Coy.....	Wm. Smerdon.....	40	Shift foreman..	Killed instantaneously.....	Standing in stope, hit by rock in the back.
3	March 14	Weedon Mine.....	Weedon Mining Co. Ltd..	L. Lizée.....	30	Miner's helper..	Wounds head and body.....	Premature explosion; probably due to defective fuse.
4	" 14	" " " " " "	" " " " " "	A. R. McDougall..	36	Miner.....	Contusion of the back and Pelvis fractured.....	A large piece of rock rolled down from a pile, while the man was sitting, pinning him to the ground.
5	Aug. 9	Jeffrey Mine.....	The Asbestos & Asbestic Co., Ltd.....	Alcidas Bisson....	33	Driller.....		
6	Aug. 21	Johnson's Pit, Thetford Mines..	Johnsons' Company.....	John Gerliak.....	30	Labourer.....	Fractured skull.....	By a stone falling out of a box of ore hoisted from pit, stone 2in diam. striking him on the head.
7	Aug. 28	Jeffrey Mine.....	The Asbestos & Asbestic Co., Ltd.....	Azhulij Kupuaieko.....	40	Labourer.....	Compound fracture of skull.....	Struck on head by hoisting rope pulley wheel, when 1 3-4" wrought iron welded link connecting cable and anchorage broke. As the cable fell down it brought with it the hoisting rope and the pulley wheel.
8	Nov. 24	Jacobs' Mine.....	Jacobs Asbestos Mining Co.	Magloire Boissonneau.....	57	Pit Labourer....	Fractured skull.....	Premature explosion; by one man making electric wire connections before notice was given him that switch was open.
9	Dec. 31	Eustis Mine.....	Eustis Mining Coy.....	W. Brimblecombe	27	Machine helper	Broken neck.....	Piece of rock dropped from roof unto the man's neck.

On January 26th.—John Bérard, employed by the Jacobs Asbestos Mining Co., Ltd., was working in the concentrating mill as sweeper. His clothes were caught by a 3" shaft, situated 40" above the fourth floor. The probability is that the victim, to save a few steps, attempted to pass over the shaft.

VERDICT :—Accidental death, recommending a closer watch of dangerous places.

On February 27th.—Wm. Smerdon, foreman for the Eustis Mining Company, was instantaneously killed by a stone detached from the roof which struck him in the back, when in a stope on the 9th level, giving orders to a machine-runner. The roof of this stope had been scaled the preceding week and was considered in good condition.

On March 14th.—Archie McDougall and Jos. Lizée were killed by a premature explosion at the McDonald mine at Weedon.

From the testimony of the witnesses at the inquest, it has been established that at 4.50 a.m. on Saturday, March 14th, Clarence Young gave the signal to "spit" the fuses on the 4th level, where McDougall and Lizée were working, and was terrified to hear the explosion about half a minute later. The blast was a premature one and the two workmen were killed. The holes are usually fired by means of seven-foot fuses, burning at the rate of a foot per 40 seconds. Usually, after the signal "Fire Away", there is a lapse of time equal to from six to eight minutes before the explosion, thus giving the men all the time they need to reach the shaft whence they are hoisted up. The probability is that the accident was caused by a quick burning fuse.

On August 9th.—Alcidas Bisson, driller, employed for the Asbestos & Asbestic Co., Limited, died from an accident which occurred on July 3rd, 1913. He was struck by a large stone, which rolled down from a pile, while drilling a hole in a sitting position. It was found that he had the pelvis fractured and contused wounds of the hip and back. Accidental death was the verdict.

On August 21st.—At the Johnson Mine, Thetford Mines, John

Gerliak, labourer, working in the bottom of the pit, had his skull fractured by a stone, $2\frac{1}{2}$ ", which fell from the box of a cable-derrick, while ore was being hoisted. It was established at the inquest that this man was standing three feet to the side from under the box. The victim died twenty days after.

On August 28th.—At the Jeffrey mine, owned by the Asbestos and Asbestic Co., Ltd., a new $1\frac{3}{4}$ " wrought iron welded link, used to connect the cable with the anchorage, gave way, owing to the welded joint in the link opening up for some unknown reason; the whole cable fell down, bringing with it the hoisting rope and the hoisting rope pulley wheel, the pulley wheel striking Azhuij Kupuaeiko on the head, causing his death, due to a compound comminuted fracture of the right parietal bone, and a compound fracture of the superior maxillary into the antrum. He died eight hours later. One of the cables fell on Alexander Ramsay, labourer, fracturing his left femur and causing severe contused wounds to the left arm.

On November 24th.—Six labourers were blasting the cover of frozen earth on the east side of the pit at the Jacob mine, Thetford Mines. One of the holes was to be fired by electricity from a 110-volt circuit. A switch had been placed in a box with a padlock, but a section of the wire was used to signal the hoistman. Before blasting, it was the practice to open the circuit used for signalling, to connect the electric wires with the wires of the detonators, and to spread the electric current by closing the above switch. Cormier had connected the wires before the signal circuit was open, and, later on, when signalling to the hoistman, he closed the circuit and the charge exploded. Boissonneau and Jolicoeur were thrown down the pit from a height of 80 feet. The former fractured his skull and died instantly; Jolicoeur received severe contused wounds and Cormier was slightly wounded. The first cause of the accident was the use of the same circuit for two different purposes, namely: (a) to blast; (b) to give signals. The second cause of the accident was the fact of one of the men connecting the wires before receiving proper orders to do so.

VERDICT :—Accidental death ; recommendation to the company to have a special circuit for blasting purposes.

On December 31st.—At 1.30 p.m., W. Brimblecombe, a machine helper, was near the bottom of Eustis shaft, which is on an incline of 38° , leaning against the wall, waiting for the machine man who had left work for a short while, when a large scale fell from the roof, a height of about 8 feet, hit Brimblecombe on the side of the head, causing a gash at base of head and breaking his neck. Death must have been practically instantaneous. The rock which fell from the roof was flat and comparatively thin, weighing about 175 lbs. The accident occurred within a few feet from the bottom of the shaft which was being deepened, so that the surface from which the rock fell was only 3 or 4 days old. Examination of working places is carefully made every day, walls and roof being sounded with steel bars. This place had been so examined on the morning of the 31st, by F. Lemieux, miner, who has charge of this examination. No blasting took place between the time of the sounding and time of accident nearer than 130 feet. Two men have charge of examining working places every day, and examination is done carefully, as the rock is treacherous. It oxidizes easily. The opening in sinking shaft is 17 feet wide by 7 feet high, on slope of 38° .

VERDICT :—That said W. Brimblecombe, a drill helper, had come to his death by a rock falling from the roof of the incline shaft. Accidental death without attaching blame to any one.

14	Feb. 2..	Jeffrey Mine.....	Asbestos & Asbestic Co. Ltd.....	Fred. Beauchene	52	Blacksmith.....	Contused wound on right foot.....	Bar of iron fell on injured's foot. While drilling hole with a Plug driller it fell on the 3rd finger of right hand.
15	" 2..	King's Mine.....	Asbestos Corporation of Canada Ltd.....	Joseph Terrien..	23	Driller.....	3rd finger of right hand bruised....	Man was lifting a cracked rock when it split and a piece fell on his foot.
16	" 4..	Plant No. 3, Hull	Canada Cement Co. Ltd....	T. Muldowan....	26	Labourer.....	Foot bruised at the instep.....	While blowing out hole, several small pieces of stone struck left eye.
17	" 4..	King's Mine.....	Asbestos Co.p. of Can. Ltd.	Emile Brousseau.	24	Driller.....	Small pieces of stone in left eye.....	While coupling car.
18	" 7..	" " " " " "	" " " " " "	Theophile Antaya	19	Brakeman.....	Little finger of right hand badly bruised and lacerated....	While moving large rock, the hook of chain slipped and caught his finger between the chain and hook.
19	" 9..	Jeffrey Mine.....	Asbestos & Asbestic Co. Ltd.....	Arch. Roux.....	46	Labourer.....	Contused wound in index finger right hand.....	Put his foot in one of the excen- tric of engine and as it moved a round his toes were caught between the excen- tric cup and the bolt which was protruding out over the cup.
20	" 12..	" " " " " "	" " " " " "	Honoré Gosselin..	28	Carpenter.....	Compound fracture of great and next toes.....	A piece of dynamite became frozen in a hole and injured endeavoured to force the dynamite into the hole by tapping it with a wooden stick when dynamite exploded.
21	" 14..	" " " " " "	" " " " " "	Rosario Dumont	31	Labourer.....	Punctured wound at center of lower border of upper lid passing through lid and cornea.....	While loading a hole with dynamite the dynamite had frozen and in his endeavor to force it by tapping with a stick caused an explosion.
22	" 14..	" " " " " "	" " " " " "	Joseph Lavigne....	27	Labourer.....	About fifty contused wounds on head and face and perforation of right cornea and upper and inner cornea.	While cobbling in the bottom of pit a box struck him on the head and knocked him down
23	" 21..	" " " " " "	" " " " " "	Adélaïd Mailhot..	42	Cobber.....	Contused wound left knee and sprain to left ankle.....	While breaking stone, a little piece flew into eye.
24	" 23..	King's Mine.....	Asbestos Corp. of Can. Ltd	Aimé Lachance..	32	Miner.....	Piece of stone in left eye.....	Piece of rock rolled down from pile of rock and struck injured.
25	" 25..	Jeffrey Mine.....	The Asbestos & Asbestic Co. Ltd.....	Cleopse Dpoko....	18	Labourer.....	Contusion of lower third of right thigh and sprain right knee.	

NON-FATAL ACCIDENTS, 1914.—Continued.

No.	Date	Mine and Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Injury	Cause of accident
26	" 25.	Jeffrey Mine....	The Asbestos & Asbestic Co., Ltd.....	Oscar Foucault...	26	Driller.....	25 to 30 contused wounds on face and head, right lower eye, lid perforated.	A block hole had been loaded with dynamite to be blasted but the fuse was cut by a piece of rock. Injured in thawing out rock drill next morning made a fire on the top of the fuse and charge exploded.
27	March 3	" "	" " " "	Pawawa Prouka..	27	Labourer.....	Contusion and sprain of right knee.....	Piece of rock rolled down from pile of rock and struck injured on the knee.
28	" 3	" "	" " " "	Arthur Wilson....	18	Labourer.....	Fracture of bone of 3rd toe left foot.	While assisting to rivet two sheets of steel plates and in turning them over the plates slipped and struck injured's toes.
29	" 4	New Rockland Slate Quarry..	New Rockland Slate Co....	Napoléon Lavallée	39	.....	Three ribs broken contusions on head and internal injury.	Slipped and fell a distance of twenty feet into quarry.
30	" 10	Jacobs' Mine....	Jacob Asbestos Mining Co Ltd.....	Jos. Carrier.....	36	Pit labourer.....	Leg bruised.....	Leg jammed by pit-box.
31	" 14	Weedon Mine....	Weedon Mining Co. Ltd....	Daniel McLeod...	51	Foreman.....	Two ribs broken and kidney injured.	Foot slipped on ladder on 200 foot level of mine.
32	" 18	Jacobs' Mine.....	Jacob Asbestos Mining Co. Ltd.....	Alfred Morissette	31	Pit labourer....	Head and shoulder bruised.....	A rock broke while being hoisted and struck the man on the side of head and shoulder.
33	" 18	King's Mine.....	Asbestos Corp. of Can. Ltd	Gaston Witlebold	24	Cobber.....	Fracture of skull.....	In the course of moving "loose" a stone fell from the side of one of the pits. Striking another stone at bottom of pit, broke, one of the pieces (7 lbs) rebounding a distance of 100 ft, struck victim on the head, while he was cobbing.

34	"	25 Johnson's Mine at Thetford Mines.....	Johnson Co.....	Joseph Bédard....	30	.....	Second finger of right hand broken and 1st and 3rd fingers bruised.
35	"	30 Beaver Mine.....	Asbestos Corp. of Can. Ltd.	A. Labbé.....	40	Loader.....	Cut two inch long on left wrist and bruise on left arm.....
36	"	30 Rock Quarry Plant No. 3 (Hull)	Canada Cement Co. Ltd..	A. Orelnsky....	28	Quarry men....	Two hands crushed.
37	"	30 Jeffrey Mine.....	The Asbestos & Asbestic Co. Ltd.....	William Jones....	20	Apprentice Machinist.....	Fracture of right arm.....
38	April 1	" " "	" " "	Leo Banar.....	35	Labourer.....	Compound fracture of 3rd and 4th metacarpal bones of left hand and hand generally badly injured.
39	"	2 King's Mine.....	Asbestos Corp. of Can. Ltd.	Joseph Boisselle...	21	Miner.....	Left eye injured by stone.....
40	"	4 Jacob's Mine.....	Jacob's Asbestos Mining Co. Ltd.....	Tom Wright.....	43	Mill labourer...	Right arm broken.
41	"	7 Jeffrey Mine.....	Asbestos & Asbestic Co. Ltd.....	Aimé Vincent.....	27	Labouret.....	Contusion and sprain of right knee joint..
42	"	16 Eustis Mine.....	Eustis Mining Co.....	Reginald Harvey..	28	Timberman....	Compound fracture of left leg below knee, leg almost severed from body, only hanging by skin.
							Harvey and help, walking up the shaft. A piece of timber which was being let down from surface in the skip somehow got loose and slid, down the track striking Harvey in the left leg below the knees.

NON-FATAL ACCIDENTS, 1914.—Continued.

Nos	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Injury	Cause of Accident.
43	April 18	King's Mine.....	Asbestos Corp. of Can.....	Jos. McCutcheon.	38	Miner.....	Left shoulder bruised and sprained.	While loading boxes with rock a stone fell from the side of one to his shoulder.
44	"	23 Jeffrey Mine.....	The Asbestos and Asbestic Co. Ltd.....	Harry Finnegan...	22	Brakeman.....	Amputation of 1st phalangeal articulation of middle finger of right hand.....	Large piece of rock fell on his finger crushing it off at first joint.
45	"	23 B. & A. Asbestos Co.....	B. & A. Asbestos Co.....	Waseł Bondorowsky.....	45	Miner.....	Fracture of tibia. R. L. contusions L. knee and foot and contusions and L. fore-arm.	Rock slide.
46	"	25 King's Mine.....	Asbestos Corp. of Can.....	Philéas Ferland..	26	Miner.....	Left foot sprained & bruised....	While pulling loose rock from the side of pit, a stone, rolled on his left foot.
47	"	25 Jeffrey Mine.....	The Asbestos and Asbestic Co. Ltd.....	A. Lahriduck.....	42	Labourer.....	Three contused wounds upper third left leg...	Large piece of rock rolled down from pile of rock, his left leg being caught between the rock and the side of the box.
48	"	25 Granite Quarry...	The Laurentian Granite Co. Ltd.....	Donat Levellé.....	17	Labourer.....	Hand bruised.....	While turning grindstone, his hand jammed between tool and grindstone.
49	"	27 British Canadian Mine.....	Asbestos Corporation of Can. Ltd.....	Joseph Slovic.....	41	Pit labourer.....	Double fracture of left ankle.....	Slovic was at work in bottom of pit close to the wall when a large rock which had loosened, with the frost and rain, rolled down from a height of about four feet onto his ankle.
50	May 2	Jeffrey Mine.....	The Asbestos & Asbestic Co. Ltd.....	Napoleon Moyen.	30	Labourer.....	Contused fractured wound between metatarsal bones of little and next toe left foot.....	Piece of boiler plate slipped from the table of the drill one of the corners of which struck his left foot.
51	"	5 King's Mine.....	Asbestos Corp. of Can. Ltd.	Laurent Turcotte.	17	Miner.....	Right eye injured by a small stone...	While breaking rock a bit of stone flew into his right eye.
52	"	5 Hull Plant.....	Canada Cement Co.....	Y. Deutyk.....	43	Labourer.....	Back injured.....	Injured was loading rock and when barring up some rock it loosened quickly and he fell about four feet hurting his back.

53	May	6	Jeffrey Mine....	The Asbestos & Asbestic Co. Ltd.....	Rail Marfink.....	25	Labourer.....	Fracture of 9th and 10th ribs also scalp wound....	Empty box descending down the pit struck him on the head and back knocking him down.
54	"	16	Granite Quarry...	The Laurentian Granite Co., Ltd.....	Hector Lapointe...	20	Labourer.....	Knee cut on sharp stone.....	While walking on stone in quarry slipped and fell on sharp stone.
55	"	19	Kings' Mine.....	Asbestos Corp. of Can. Ltd.	Onésime Gagné...	21	Cobber.....	Index finger of left hand crushed and bruised.....	Man was working at side of pit when large stone rolled down from above onto his hand.
56	"	25	" "	" " " "	Gaudias Gagnon...	24	Driller.....	Right leg badly bruised.....	Gagnon was struck by a large piece of rock from blast.
57	"	26	Granite Quarry....	James Brodie.....	Wm. Derusha....	28	Quarryman....	Tips of two fingers jammed.....	Was lifting small piece of stone with iron bar when it slipped and came back catching his fingers.
58	"	28	Kings' Mine.....	Asbestos Corp. of Can. Ltd	Cléophas Fredette	31	Miner.....	Second finger right hand crushed...	While turning over a stone; another stone rolled over and badly crushed finger.
59	"	29	" "	" " " "	Emile Lessard.....	15	"	Index right hand crushed.....	While loading box with rock, finger was crushed between two pieces of rock.
60	June	2	Lachance Quarry.	J. E. Baker.....	Albert Lambert...	34	Dynamite man.	Cut to right hand and small finger severed.	While springing a hole—caused by defective fuse.
61	"	2	Kings' Mine.....	Asbestos Corp. of Can. Ltd.	Rosario Tetreault.	18	Labourer....	Inflammation of left eye.....	While sledging rock piece flew up and hit victim in left eye.
62	"	3	Granite Quarry....	The Laurentian Co. Ltd.	Austin Boyd.....	24	"	Foot bruised and crushed.....	While barring stone, slipped and foot was caught in the rolling stones.
63	"	4	" " ..	" " " "	Oscar Charron....	18	"	Burns.....	Was standing near pipe end, when steam escaped.
64	"	9	Hull Plant.....	Canada Cement Co.	R. Grey.....	55	Foreman	Kicked in the face by horse.....	While endeavouring to unhitch a team of horses that had fallen over a bridge to the ground one of them kicked him in the face.
65	"	11	Kings' Mine.....	Asbestos Corp of Can Ltd	Arthur Caron....	22	Driller.....	General shock, face and fingers of right hand covered with little pieces of rock in flesh, serious cut on front part of R. leg, and other wounds.	While drilling a block hole in rock at bottom of pit, drill struck an unexploded charge of dynamite in block hole on the other side of rock, which had missed fire in the general blast some hours previously.

75	"	14	Granite Quarry....	The Laurentian Quarry Co. Ltd.....	Eugene Richard...	35	Laborer.....	Hand cut and bruised.....	Was handling hand car loaded on stone rolled over and fell on his hand.
76	"	15	No. 2. Pit.....	Martin-Bennett Asbestos Mines Ltd.....	Wilfrid Huot.....	18	Labourer.....	Cut on hand and sinews of neck strained.....	In giving signals to hoist pit box was caught by box and lifted 15 ft. and fell.
77	"	15	Delson Jet. Brick Plant.....	National Brick Co of Lachine, Ltd.....	Geo. Kirby.....	21	Brakeman.....	Heel bruised, ankle crushed, and small bone broken.....	In making coupling two freight cars, the injured placed his foot on coupling to straighten it and foot was caught between the two.
78	"	15	Limestone Quarry	Wright & Co. Incorp.....	Hackman.....	20	Brakeman.....	Ankle injured.....	While riding on cars.
79	"	17	Bell Mine.....	Bell Asbestos Mines.....	Omer Ouellet.....	20	Brakeman.....	Left thigh bruised.....	When coupling car to a locomotive he got his left thigh jammed between the drawbar, of a car and bunter of locomotive.
80	"	17	Jeffrey Mine.....	The Asbestos & Asbestic Ltd.....	James Coyle.....	31	Machinist.....	Punctured wound, pain surface, left hand.....	On reaching over to repair a cyclone drill piece of wire entered injured's hand.
81	"	23	Rogers & Quirk's Quarry.....	Rogers & Quirk.....	Henri Nantel.....	33	.....	Thumb of left hand bruised, had one joint amputated	Rope of drilling machine caught his thumb between wheel and strand of rope due to machine man starting engine before signalled.
82	"	24	Jeffrey Mine.....	Asbestos & Asbestic Co. Ltd.....	Voverind Macheski.....	94	Labourer.....	Severe contusion of left hip.....	Injured slipped of stand falling to ground his hip striking rail of narrow gauge track.
83	"	24	" " " "	" " " "	Louis Voyer.....	58	Labourer.....	Contusions (lower third) right leg and ankle.....	While assisting to fill an empty box with rock a large piece of rock rolled down the pile, his right hand being caught between the box and the rock.
84	"	28	" " " "	" " " "	Alfred Gilbert.....	24	Labourer.....	Fracture 6th and 7th ribs anterior left side.....	While carrying 100 lbs bag of asbestos fibre up a staging he slipped throwing him on one side his left side striking the edge of the staging.
85	"	28	" " " "	" " " "	Omer Provencher.	20	Labourer.....	Fracture 2nd phalanx of large toe left foot.	While endeavouring to clear crusher of a piece of rock another piece rolled down striking injured's foot
86	"	30	" " " "	" " " "	Octave Boisvert...	38	Labourer.....	Fracture of base of 2nd metatarsal	A large piece of rock rolled down on his foot while loading an empty box with rock.
87	"	31	" " " "	" " " "	Tecob Tubin.....	25	Labourer.....	Lacerated wound of left leg, about the middle.	Large piece of rock rolled down the pile, injured leg being caught between the rock and side of box.

NON-FATAL ACCIDENTS—Continued.

Nos	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Injury	Cause of Accident.
88	July 31	Bell Mine.....	Bell Asbestos Mine.....	W. Grimard.....	26	Electrician.....	Electric Shock.....	Injured happened to touch a 2200 volts wire with his right ear.
89	Aug. 4	Jeffrey Mine.....	The Asbestos & Asbestic Co., Ltd.....	Sidney Bristow...	30	Labourer.....	Contusion cervical and upper dorsal region of neck.	Bag fell down chute striking injured on the neck.
90	" 7	" "	" "	John Arsenaault....	37	Labourer.....	Contused wound lower third right arm.....	Piece of rock rolled down from pile striking injured on the arm.
91	Aug. 8	Martin Bennett..	Martin Bennett Asbestos Co., Ltd.....	Treffé Cliche....	35	Labourer.....	Leg hurt.....	Rock rolled from jam.
92	" "	Granite Quarry..	The Laurentian Granite Co. Ltd.	Hermas Bigras....	26	Quarryman....	To hip and stomach	A steam pipe burst and trying to escape for steam, he jumped and missed spot, fell amongst broken stone.
93	" 15	Limestone Quarry	Wright & Co., Inc.....	Waryl Moroy....	35	Labourer.....	Lost hand.....	While going in front of moving car.
94	" 15	Jeffrey Mine.....	The Asbestos & Asbestic Co. Ltd.....	Absolom Labrecque.....	38	Labourer.....	Infected necressed wound.....	Piece of rock rolled down from pile and struck injured on the hand.
95	" 18	La C. des Carrières	Marc Nault.....	Jos. Nault.....	19	Labourer.....	Hand crushed.....	By a stone.
96	" 19	Jeffrey Mine.....	The Asbestos & Asbestic Co. Ltd.	André Lenement.	44	Labourer.....	Severed contused wound left leg lower third.	Piece of rock rolled down from piles struck injured on leg.
97	" 28	" "	" "	Alex. Ramsay...	59	Labourer.....	Compound comminuted fracture left femur and severe contused wound left arm.	A new 1 3-4" wrought iron welded link used to connect the cable, with the anchorage gave way owing to the welded joint in the link opening up, for some unknown reason, the whole fell down bringing down with it the hoisting rope and hoisting rope pulley wheel. The cable falling on injured's left leg and throwing him down.
98	" 31	" "	" "	Edward Martin..	35	Carpenter.....	Injury of index and 2nd finger right hand.	Caught his fingers in rip saw.

99	"	31	"	"	"	"	"	Napoléon Ouellete	57	Labourer.....	Infected wound palm of right hand..	While greasing the excentrics of shaking screens a blister formed which broke causing infected wound.
100	Sept.	3	"	"	"	"	"	Elaouis Hewvylas	35	Labourer.....	Fracture of 4th metatarsal bone left foot.....	Large piece of rock rolled down from pile of rock and struck injured foot.
101	"	14	"	"	"	"	"	Wallace Livingstone.....	.....	.....	Contused wounds of 1st 2nd and 3rd fingers left hand.	Injured placed his fingers between the frame of a motor causing the above accident.
102	"	15	"	"	"	"	"	Henri Vincent...	56	Foreman.....	Severe contusions of left side.....	Knocked down by car on narrow gauge truck which struck him on his left side...
103	"	15	"	"	"	"	"	Vila Boucher.....	27	Labourer.....	Dislocation of right ankle.....	While proceeding to battery to blast in the pit one of the legs of injured's overalls caught in the reel around which the wire was rolled which threw him down.
104	"	18	"	"	"	"	"	Joseph Gauron....	45	"	2nd finger right hand crushed.....	A wrench slipped from injured's hand striking one of the cogs of locomotive his finger being caught between wrench and edge of one of the teeth of cog.
105	"	22	"	"	"	"	"	Francis Levesque..	34	"	Contusions to right ankle.....	Large piece of rock rolled down from pile of rock striking injured's right leg.
106	"	22	Deschambault Quarry.....	"	"	"	"	Philippe Langlois.	23	"	Right foot crushed...	Fall of a piece of rock.
107	"	25	Martin Bennett..	"	"	"	"	Daniel Lamothe..	32	Labourer.....	Cut about the face..	Stone from blast struck window which he was near a piece of glass cut his face.....
108	"	28	Jeffrey Mine....	"	"	"	"	James Stewart....	54	"	Two contused wounds right leg	While placing an empty box to be filled with rock, hoisting rope tightened causing the box to lift and swing injured's right leg being caught between box and large piece of rock.
109	Oct.	1	"	"	"	"	"	Robert Smith.....	20	Machinist.....	Contusion 2nd finger right hand....	In assisting to place rails on a truck injured's finger was caught between two of the rails.

123	"	17	Bell Mine.....	Bell Asbestos Mine.....	Arthur Percival .	27	Labourer.....	Browout above right eye.....	Fell on track with a tie on his shoulder.
124	"	19	Martin Bennett...	Martin Bennett Asbestos Mines Ltd.....	Edouard Turcotte	24	Labourer.....	Toes crushed.....	In lifting rock let it fall on his foot.
125	"	24	Jacob's Mine.....	Jacobs Asbestos Mining Co. Ltd.....	Arthur Cormier...	.....	Labourer.....	Contusion of thigh and third finger of right hand cut.....	Premature blast, caused by this man making wire connection before notice being giving him that switch was open.
126	"	24	"	"	Arthur Jolicœur.....	.....	"	Contusion of spine cuts on head...	Premature explosion, by one man making wire connection before notice being given him that switch was open
127	Dec.	1	Shale Mine.....	Citadel Brick & Paving Block Co.....	Jean Nadeau.....	35	Miner.....	At the head.....	Landslide 25 feet high hitting the injured.
128	"	2	Eustis Mine.....	Eustis Mining Co.....	Roy Beattie.....	18	.....	Left foot taken off just above ankle on foot crushed.	Run over by electrically operated train.
129	"	7	Quarry.....	La Cie des Carrières.....	Lorenzo Baril....	20	Labourer.....	Sprain right knee joint.	By a stone rolled over.
130	"	10	Jeffrey Mine.....	The Asbestos & Asbestic Co Ltd.....	Edward Thompson.....	33	Labourer.....	.....	Large piece of rock rolled down from pile and struck injured's knee.

ALPHABETICAL INDEX

	Page		Page
Accidents in mines	120	Chromite deposits	31
Accidents, fatal	123	Chromite, list of operators..	105
Accidents, non-fatal	124	Chromite, production	9
Aluminium	28	Clay products, production ..	9
Asbestos list of operators....	104	Clays, vitrifying	74
Asbestos, production	9	Clowes claims	42
Asbestos and Asbestic Co....	21	Comp. Gaz et Petrole St.	
Asbestos Corporation of		Barnabé	64
Canada.....	22	Compagnie Gaz Naturel de	
Asbestos, statistics and pro-		Québec.....	59
duction.....	17	Copper.....	27
Asbestos in Australia	23	Copper, list of operators....	105
Assay laboratory, fees	14	Copper and Sulphur, pro-	
Austrian magnesite deposits.	69	duction.....	9
		Cushman and Coggeshall,	
Bancroft, Dr. J. A., work by	11	quoted	85
Beaudoin, P. E.	27		
Beaver Asbestos Co.....	23	Decarie et Fils	98
Bell mine, asbestos.....	23	Diamonds in chromite.....	34
Black Lake Asbestos and		Dominion Chrome Co.....	37
Chrome Co....	22, 31	Dresser, J. A., chrome de-	
Brick, list of operators	111	posits	32
Brick, production	9	Dubuisson, township	42
Brick and Tile Company....	101	Dufresne, A. O., accident	
Building stone	72	report.....	120
		Dufresne, A. O., appoint-	
Cabane Ronde, natural gas.	51	ment of....	15
Calumet, magnesite	68	Dufresne, A. O., on sand,	
Canada Brick Co., Ltd.....	99	lime brick....	88
Canada Iron Corporation....	42		
Canada Iron Foundries, Ltd.	42	Eustis Mining Co.....	27
Canadian China Clay Co...78-81		Explosives, handling of.....	130
Canadian Gas and Oil Co..60-61		Exports of minerals, pro-	
Canadian Natural Gas Co... 65		hibited.....	15
Cement, producers	117		
Cement, production	9	Fatal accidents, descriptions	
Chemical Laboratory	13	of.....	133
China clay, operators	118	Fatal accidents, list of.....	132
China clay, production	9	Fatal accidents, proportion.	122
Chrome, Dresser on chrome		Feldspar, Mingan	87
deposits	33	Feldspar, list of mine	
Chrome, New Caledonia	32	owners.....	117
Chrome, Rhodesia production	32		

	Page		Page
Feldspar, production	9	Mica, production	9, 46
Field work, importance of..	12	Mineral paint	42
Gold, list of producers.....	108	Mineral paint, producers ...	108
Gold, production	9	Mineral paint, production ..	9
Gold and silver	41	Mineral production, table ..	9
Granite, production	9	Mineral water, producers ...	105
Granite, quarry operators ..	117	Mineral water, production ..	9
Graphite.....	29	Mining prospectuses..	12
Graphite, list of operators..	106	Molybdenite concentration ..	44
Graphite, production	9	Molybdenite, demand for....	43
Graphite in Madagascar	30	Molybdenite occurrences	43
		Molybdenite, owners of mines	108
Hall-Heroult process	29	Montreal Pit, chrome	37
		Montreal Silicate Brick Co..	89-99
Information on mines	12	National Gas Company	65
Inspection of mines	15	Natural gas companies	48
Iron, mine operators	106	Natural gas, laws	10
Iron mining in Quebec.....	42	Natural gas, list of operators	106
Iron oxide	42	Natural gas, Three Rivers	
		district.....	49
Jeffrey mine	129	Non-fatal accidents, list....	136
Johnstone, R. A. A., dia-		Northern Aluminium Co....	29
monds in chromite	34	Notre-Dame de Grâce, oil....	68
Joliette, sand for silica brick.	101		
		Ochre.....	42
Kaolin.....	78	Ochre, producers	108
Kaolin, operators	118	Ochre, production	9
Kaolin, production	9	Oil on Montreal island.....	68
Kaolin, prospecting for.....	81	Oil lands, laws.....	10
Keele, J., report on clay....	74		
Kewagama lake	43	Parks, Dr. W. A., quoted..	72
Kienawisik lake	42	Peat, operators	110
		Peppel, S. V., on silica brick	93
Labour statistics in mines..	120	Petit-pré, mica mine	47
Laurentide Mining Co.....	28	Phalen, W. C., quoted.....	84
Lead, list of operators.....	110	Phosphate, list of producers.	108
Lead ores	28	Phosphate, production	9
Lead ores, production.....	9	Pointe-aux-Trembles, silica	
Legislation.....	10	brick plant	101
Lévis, vitrifying clay.....	76	Potash deposits of Germany.	82
Lime, kiln operators	116	Potash in feldspar	82
Lime for silica brick.....	91	Pottery, clay pits operators.	119
Limestone, production	9		
Limestone, quarry operators.	113	Quebec Fuel Co.....	63
Louiseville, natural gas	61	Quebec Graphite Co....	30
Magnesite.....	68	Richard mine, mica.....	47
Magnesite, analyses	71		
Magnesite, operators	106	Sand, producers	109
Magnesite, production	9	Sand production	9
Marble, quarry operators....	118	Sand for silica brick	89
Martin-Bennett Asbestos Co.	23	Sand-lime brick	88
Mica, list of operators.....	106	Sand-lime brick, tests of....	95
Mica, prices in 1914.....	47	Sandstone, production	9
		Sandstone, quarry	117

	Page
Sherbrooke, clay	77
Silica brick in United States	88
Silica brick, manufacturers..	113
Silica brick, tests of.....	95
Silicate Brick Co....	88
Sillery, vitrifying clay.....	74
Silver.....	41
Silver, list of producers.....	104
Slate, list of operators	111
Slate, production	9
South Durham, sand.....	99
Spar Chemical Co.....	84
Statistical Review	7
St. Amable, natural gas	56
St. Appollinaire, clay	76
St. Barnabé, natural gas....	55
St. Chs., Bellechasse, clay..	76
St. Gregoire, natural gas....	51
St. Joseph de Lévis, clay....	76
St. Lambert, silica brick plant.....	100
St. Rémi, d'Amherst, kaolin	79
St. Roch, drilling or gas....	63
Sullivan claims.....	42

	Page
Talc, mine owners	110
Tasmania, asbestos	26
Tetrault, Pierre	28
Titaniferous iron ores, mine owners.....	107
Tyrrell, J. B., on feldspar deposit	87
Verchère, drilling for oil....	64
Wages to miners	120
Weedon Mining Co., copper mine.....	27
Weedon Mining Co., zinc and lead	23
Workmen in mines and quarries	121
Yamachiche, natural gas....	61
Yamaska, bore-holes	63
Zinc, list of operators.....	110
Zinc ores	23
Zinc ores, production	9

